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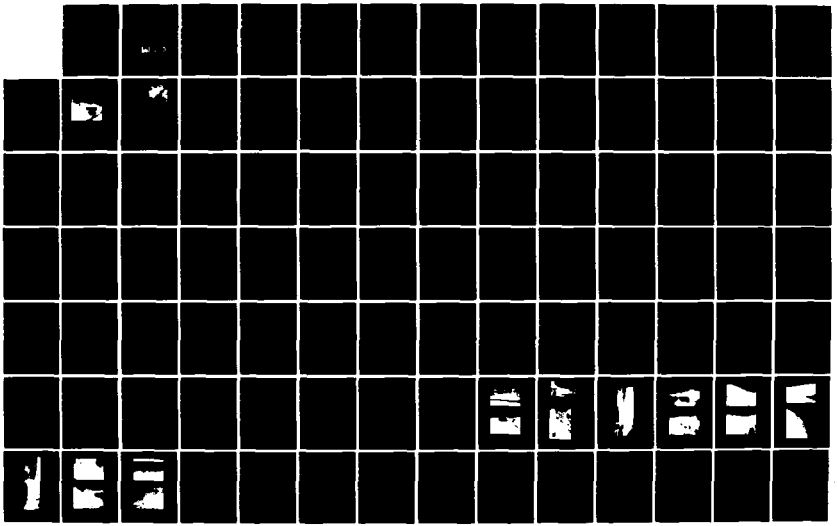

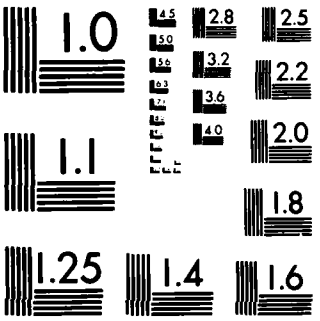

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MERRIMACK RIVER BASIN
FITCHBURG, MASSACHUSETTS

SNOWS MILL POND DAM
MA 00878

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

FEBRUARY 1979

UNCLASSIFIED

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Fitchburg Massachusetts
Whitman River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam consists of an earth dike, about 250 ft. long on the left bank of the river, and a z-shaped stone masonry spillway about 212 ft. long. The dam itself is generally in good condition. There was no evidence of settlement, lateral movement or other signs of structural failure. It is small in size with a high hazard potential.

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REPLY TO
ATTENTION OF:

NEDED

JUL 10 1975

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

I am forwarding to you a copy of the Snows Mill Pond Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, James River Massachusetts, Inc., P.O. Box 310, Fitchburg, Massachusetts 01430, ATTN: Mr. Leo P. Collette, Jr., Chief Engineer.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely yours,

Max B. Scheider

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MERRIMACK RIVER BASIN
FITCHBURG, MASSACHUSETTS

SNOWS MILL POND DAM

MA 00878

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS 02154

FEBRUARY 1979

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM

Identification No.:	MA 00878
Name of Dam:	Snows Mill Pond
Town:	Fitchburg
County:	Worcester
State:	Massachusetts
Stream:	Whitman River
Date of Site Visit:	16 November 1978

BRIEF ASSESSMENT

Snows Mill Pond Dam consists of an earth dike, approximately 250 ft. long, on the left bank of the river, and a Z-shaped stone masonry spillway about 212 ft. long. The 28 ft. high dam was built prior to 1924 to impound water for paper processing mills, and is still used for that purpose. Outlets consist of a 48-in. pond drain, a 42-in. penstock to a generating station downstream and a 12-in. supply line, all passing through a control tower between the dike and spillway.

Due to the extent of downstream development that would be affected in the event the dam were to fail, Snows Mill Pond Dam is confirmed as having a "high" hazard potential in the Corps of Engineers National Inventory of Dams.

The dam itself was generally in good condition, based on a visual examination of the structure. There was no evidence of settlement, lateral movement or other signs of structural failure or other conditions which would warrant urgent remedial action. However, the need for further engineering investigations necessitates an overall condition rating of fair.

Based on size (small) and hazard potential (high) classifications in accordance with Corps of Engineers guidelines, the test flood for this dam is one-half the Probable Maximum Flood (1/2 PMF). Hydraulic analyses indicate that the test flood outflow of 15,800 cfs (inflow 16,600 cfs or 604 csm) would overtop the dam by about 2 ft. With the water level at the top of the dam, the ungated spillway capacity is 8,500 cfs, which is 54 percent of the test flood.

James River Massachusetts, Inc., owner of the dam, should engage a registered professional engineer to 1) perform additional hydrologic studies and evaluate the stability and resistance of the earth dike to overtopping,

and 2) evaluate the seepage that is occurring at the base of the stone masonry wall on the downstream side of the dike and through the stone masonry of the spillway walls, as outlined in Section 7.2.

The corrective measures recommended by the engineering investigations and remedial measures, including the repair of minor surface erosion on the upstream side of the dike embankment, repair of voids in the stone masonry walls and maintenance of the right gatehouse, as outlined in Section 7.3, should be implemented by the owner within one year after receipt of this report. As also recommended, a program of periodic technical inspections should be instituted.

HALEY & ALDRICH, INC.
by:

Peter L. LeCount
Vice President

This Phase I Inspection Report on Snows Mill Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of Chief of Engineers, Washington, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential. Consideration of downstream flooding other than in the event of a dam failure is beyond the scope of this investigation.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

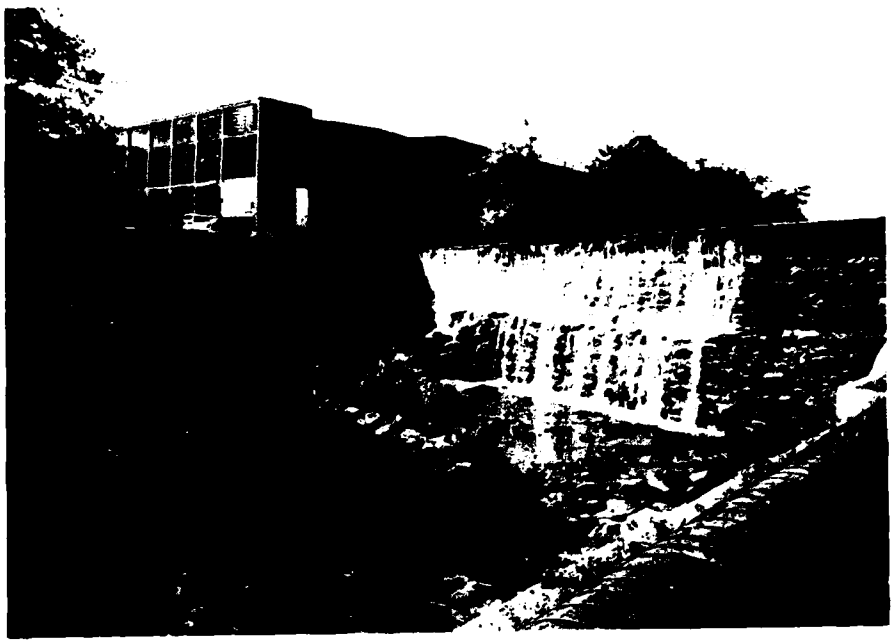
Section	Page
LETTER OF TRANSMITTAL	
BRIEF ASSESSMENT	
REVIEW BOARD PAGE	
PREFACE	i
TABLE OF CONTENTS	iii
OVERVIEW PHOTO	vi
LOCATION MAP	vii
1. PROJECT INFORMATION	
1.1 General	1
a. Authority	1
b. Purpose of Inspection	1
1.2 Description of Project	2
a. Location	2
b. Description of Dam and Appurtenances	2
c. Size Classification	3
d. Hazard Classification	3
e. Ownership	3
f. Operator	3
g. Purpose of Dam	3
h. Design and Construction History	3
i. Normal Operational Procedures	4
1.3 Pertinent Data	5
2. ENGINEERING DATA	
2.1 Design Data	8
2.2 Construction Data	8
2.3 Operation Data	8
2.4 Evaluation of Data	8

TABLE OF CONTENTS (Continued)

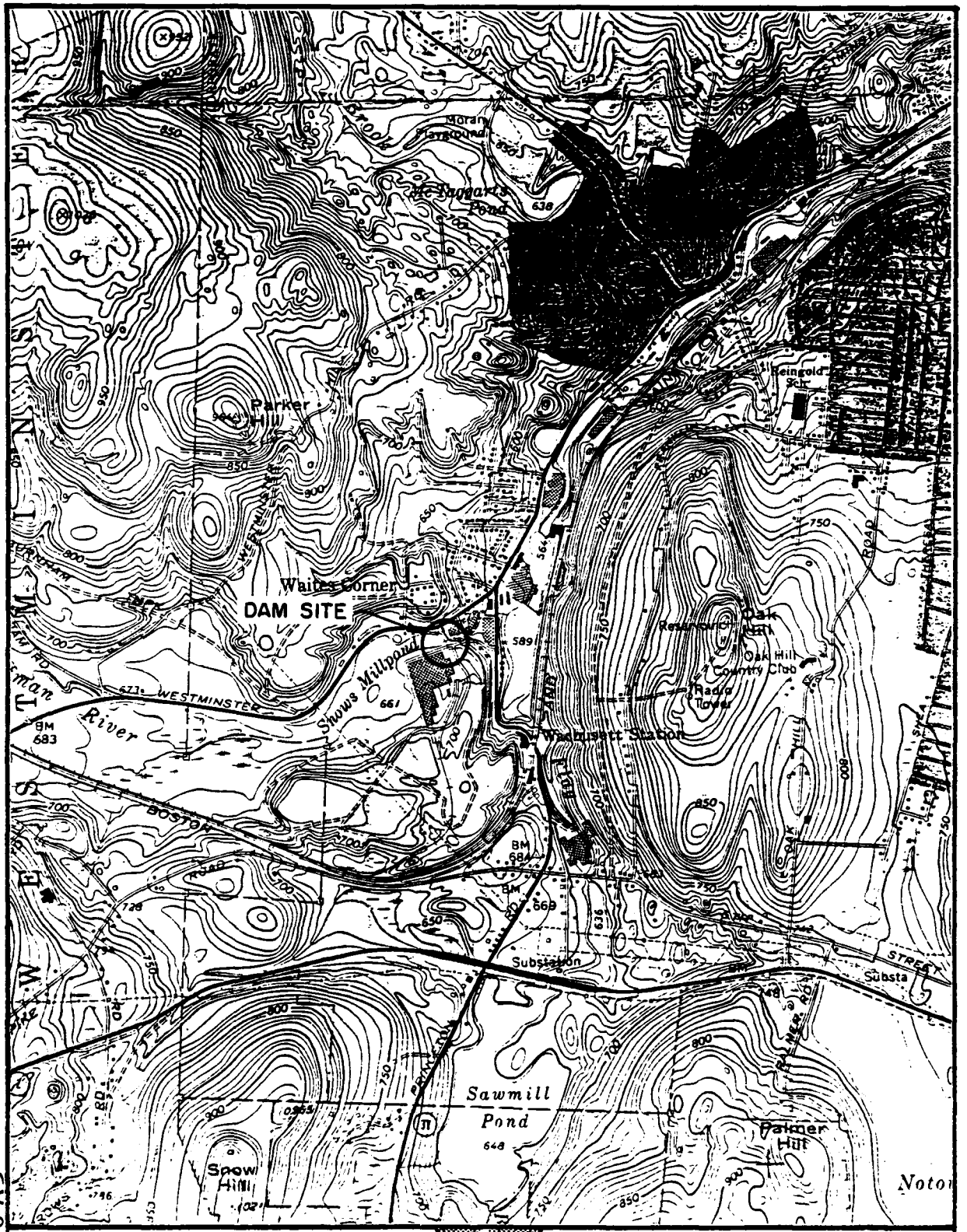
Section		Page
3.	VISUAL EXAMINATION	
	3.1 Findings	9
	a. General	9
	b. Dam	9
	c. Appurtenant Structures	10
	d. Reservoir Area	11
	e. Downstream Channel	11
	3.2 Evaluation	11
4.	OPERATIONAL PROCEDURES	
	4.1 Procedures	12
	4.2 Maintenance of Dam	12
	4.3 Maintenance of Operating Facilities	12
	4.4 Description of any Warning System in Effect	12
	4.5 Evaluation	12
5.	HYDRAULIC/HYDROLOGIC	
	5.1 Evaluation of Features	14
	a. General	14
	b. Design Data	14
	c. Experience Data	14
	d. Visual Observations	15
	e. Test Flood Analysis	15
	f. Dam Failure Analysis	16
6.	STRUCTURAL STABILITY	
	6.1 Evaluation of Structural Stability	18
	a. Visual Observations	18
	b. Design and Construction Data	18
	c. Operating Records	18
	d. Post-Construction Changes	18
	e. Seismic Stability	18

TABLE OF CONTENTS (Continued)

Section		Page
7.	ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES	
	7.1 Dam Assessment	19
	a. Condition	19
	b. Adequacy of Information	19
	c. Urgency	19
	d. Need for Additional Investigation	19
	7.2 Recommendations	19
	7.3 Remedial Measures	20
	a. Operation and Maintenance Procedures	
	7.4 Alternatives	21
APPENDIX A -	INSPECTION CHECKLIST	A-1
APPENDIX B -	ENGINEERING DATA	B-1
APPENDIX C -	PHOTOGRAPHS	C-1
APPENDIX D -	HYDROLOGIC AND HYDRAULIC COMPUTATIONS	D-1
APPENDIX E -	INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS	E-1



1. Overview of Snows Mill Pond Dam, spillway portion (October 1978)



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DAM: Snows Mill Pond

IDENTIFICATION NO. MA 00878

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LOCATION MAP

USGS QUADRANGLE

FITCHBURG, MA

APPROX. SCALE: 1" = 2000'

PHASE I INVESTIGATION REPORT
NATIONAL DAM INSPECTION PROGRAM
SNOWS MILL POND DAM
MA 00878

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 28 November 1978 from Colonel Max B. Scheider, Corps of Engineers. Contract No. DACW33-79-C-0018 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/electrical and hydraulic/ hydrologic aspects of the Investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Snows Mill Pond Dam is located on the Whitman River approximately 1,500 ft. upstream of its junction with Flag Brook (which becomes the North Nashua River) in Fitchburg, Massachusetts, as shown on the Location Map, page vii. The North Nashua River joins the Nashua River 12 mi. downstream of the dam near Clinton, MA, and the Nashua River subsequently joins the Merrimack River in Nashua, New Hampshire.

b. Description of Dam and Appurtenances. Snows Mill Pond Dam includes an approximately 250 ft. long earth dike section along the left bank of the river, a 212 ft. long masonry spillway structure spanning the river, and a control tower with three outlet pipes. A gatehouse located at the right abutment of the dam is no longer in service. The configuration of the dam and appurtenances is shown on the Site Plan Sketch, page C-1.

The earth dike portion of the dam contains a 12-in. thick concrete wall exposed for about 170 ft. left from the control tower. As indicated by the drawing of this wall, page B-23, the dike is a maximum of about 15 ft. above the adjacent downstream ground surface near the control tower. The top of the concrete wall, about El. 666, is considered the top of dam. A portion of the earth berm on the downstream side of the concrete wall where the adjacent ground surface is low is retainined by vertical stone masonry walls. Towards the left end of the dike embankment, the grassed slopes are no steeper than about 3 horizontal (H) to 1 vertical (V) and grade gently into the natural riverside.

The gravity spillway is Z-shaped in plan and consists of three stone masonry walls with a concrete weir cap, as shown on the drawing included as pages B-19, B-20 and B-21. The spillway walls are apparently notched into the rock exposed in the river channel and into the riverbank near the right abutment. The elevation of the spillway crest is 661, 5 ft. below both the top of the dike to the left and below a 55 ft. long concrete training wall that extends upstream from the abandoned gatehouse at the right abutment.

The control tower located left of the spillway contains the gate operators for the three outlets passing through the structure, namely a 48-in. pond drain, a 42-in. penstock to a generating station downstream and a 12-in. supply line. A plan and sections of the control tower as it was before renovations in 1977 are shown on a drawing including as page B-22.

c. Size Classification. The storage to the top of Snows Mill Pond Dam is estimated to be 740 acre-ft., and the corresponding maximum height of the dam is approximately 28 ft. Storage of less than 1,000 acre-ft. and a height of less than 40 ft. classifies the dam in the "small" size category according to guidelines established by the Corps of Engineers.

d. Hazard Classification. Dam failure analysis computations in Appendix D which are based on "Guidance for Estimating Downstream Dam Failure Hydrograph" by the Corps of Engineers confirm that this dam has a "high" hazard potential. A failure of the dike on the left bank would cause a potential loss of life to employees at a nearby mill building. A failure of the spillway would result in a peak failure discharge estimated to be more than twice the March 1936 flood, which caused severe damage. Extensive property damage would be expected in the event of a failure of either the dike or the spillway.

e. Ownership. The current owner of the dam is:

James River Massachusetts, Inc.
P.O. Box 310
Fitchburg, MA 01430
Phone: (617) 343-3051

The dam is an integral part of the paper mill complex originally built by Crocker, Burbank and Company around 1911. The property was subsequently owned by Weyerhaeuser Company from 1961 to 1975, when the current owners took over the complex.

f. Operator. Mr. Leo P. Collette, Jr., Chief Engineer, James River Massachusetts, Inc., has been responsible for operation, maintenance and safety of the dam since 1961.

g. Purpose of Dam. The dam at Snows Mill Pond creates a water supply used by several mills to manufacture paper. There are also provisions to generate power from the water at times of high flow. However, the hydroelectric generating station located downstream of the dam is presently inoperative.

h. Design and Construction History. The current dam was built prior to 1924 to supply the Crocker, Burbank and

Company mills, although another dam may have preceded it. In any case, five drawings by H.M. Haven & A.T. Hopkins, Inc., Boston, MA and one drawing by Howard M. Turner, Consulting Engineer, Boston, MA, indicate that repairs were made to the existing masonry dam in 1924.

A timber crib earth cofferdam approximately 130 ft. upstream of the dam (see drawing, page B-20) and two temporary sluiceways were utilized to divert the river flow during the 1924 repairs. The control tower and possibly the right gatehouse were added to the dam at that time. The upstream side of the spillway walls and the concrete spillway weir cap were renovated at this time. Inspection reports from that time, pages B-3 and B-4, list Wiley & Foss, Contractors, Fitchburg, MA, as performing the work.

An inspection report dated 6 October 1938, page B-5, indicates that the embankment was then about 4 ft. higher than the spillway. A later report dated 6 January 1939, page B-6, indicates a 200 ft. length of the embankment was sandbagged, apparently as a precaution during the 1938 flood when water was about 3 ft. above the spillway. Apparently the concrete abutments were then raised or replaced by new walls to the present level of 5 ft. above the spillway, as indicated by the 1943 county inspection report, page B-7.

Construction activities relating to a new spillway cap in 1960 and rebuilding the gatehouse in 1962 are mentioned in an inspection report dated 9 November 1964. Presumably this was maintenance work performed as a result of the dam ownership changing in 1960, and no other records of these modifications were disclosed. Renovations to the dam were again made when the ownership changed in 1975. They mainly involved a new concrete weir cap and gates for the control tower outlets in 1977, and other improvements or repairs listed on page B-24.

i. Normal Operational Procedures. No written operational procedures were disclosed. The control works are operated for water supply purposes. The 12-in. water supply line from the control tower to the filters, central steam plant and No. 6 Mill is normally open and flowing at all times. The 42-in. water supply line to the hydroelectric generating station is normally closed. In order to maintain a constant flow to the pumps for the 12-in. supply line, the pond level must be maintained at spillway crest. The level of the pond is controlled

daily by an employee of the mill who makes manual adjustments at the gates of the upstream ponds.

1.3 Pertinent Data

The datum used for all elevations reported herein is Mean Sea Level (MSL). Note that the elevations given on the 1924 drawings are based on another datum which appears to be approximately 20 ft. lower than Mean Sea Level.

a. Drainage Area. The Snows Mill Pond Dam is located near the downstream end of the Whitman River, about 1,500 ft. upstream from its junction with Flag Brook which becomes the North Nashua River in West Fitchburg. The watershed above the dam is 27.5 square miles, which includes five other reservoirs with a total water surface area of about 500 acres. Most of the drainage area consists of wooded rolling terrain with occasional steep hills.

b. Discharge at Dam Site

1.	Outlet Works.....	48-in. pond drain, 42-in. penstock to hydro plant and 12-in. pipe to filter house
2.	Maximum known flood at dam site.....	5,650 cfs on 18 March 1936
3.	Ungated spillway capacity at top of dam....	8,500 cfs at El. 666.0
4.	Ungated spillway capacity at test flood pool elevation.....	15,800 cfs at El. 668.0 (dam overtopped by 2.0 ft.)
5.	Gated spillway capacity at normal pool elevation.....	Not applicable
6.	Gated spillway capacity at test flood pool elevation.....	Not applicable
7.	Total spillway capacity at test flood pool elevation.....	15,800 cfs at El. 668.0 (dam overtopped by 2.0 ft.)

8. Total project discharge at test flood pool elevation..... 15,800 cfs at El. 668.0

c. Elevation (ft. above MSL)

1.	Streambed at centerline of dam.....	638.0
2.	Maximum tailwater.....	Unknown
3.	Upstream portal invert diversion tunnel.....	Not applicable
4.	Recreation pool.....	661.0
5.	Full flood control pool.	Not applicable
6.	Spillway crest.....	661.0
7.	Design surcharge - original design.....	Unknown
8.	Top of dam.....	666.0
9.	Test flood design surcharge.....	668.0

d. Reservoir

1.	Length of maximum pool..	0.9 mi. (Est.)
2.	Length of recreation pool.....	0.8 mi. (Est.)
3.	Length of flood control pool.....	Not applicable

e. Storage (acre-feet)

1.	Recreation pool.....	316
2.	Flood control pool.....	Not applicable
3.	Spillway crest.....	316
4.	Top of dam.....	740
5.	Test flood pool.....	970

f. Reservoir Surface (acres)

1.	Recreation pool.....	42
2.	Flood control pool.....	Not applicable
3.	Spillway crest.....	42
4.	Test flood pool.....	138
5.	Top of dam.....	110

g. Dike

1.	Type.....	Earth embankment
2.	Length.....	200 ft.
3.	Height.....	Approx. 15 ft. maximum
4.	Top width.....	Approx. 10 ft. minimum, including stepped lower level where there are vertical walls

5.	Side slopes.....	Right 110 ft. long section retained by vertical walls; left 140-ft. section has approx. 3H to 1V slopes both sides
6.	Zoning.....	Unknown
7.	Impervious core.....	Unknown
8.	Cutoff.....	12-in. thick concrete wall visible for about 170 ft. left of the control tower
9.	Grout curtain.....	Unknown
10.	Other.....	Not applicable

h. Diversion and Regulating Tunnel. Not applicable

i. Spillway

1.	Type.....	Overflow, concrete-capped stone masonry gravity section
2.	Length of weir.....	212 ft.
3.	Crest elevation.....	661.0
4.	Gates.....	None
5.	U/S Channel.....	Not visible
6.	D/S Channel.....	100 ft. wide at toe, tapering to about 60 ft. near the mill building; slope relatively steep; large boulders at the apron
7.	General.....	Dam survived several historical floods

j. Regulating Outlet. The outlet in the control tower is regulated by a manually operated 48-in. gate on the pond side of an outlet chamber with a 4 ft. wide by 8 ft. high opening at the downstream side of the control tower, Photo No. 15. The invert of the chamber opening is estimated to be at El. 646.5 while the invert of the 48-in. drain gate is estimated as El. 647.25. Mr. Collette indicated that with the gate of the upstream pond closed and the pond drain open, the water level may be drawn down within 5 hours. The water level can then be lowered further to about El. 646 by opening a mud gate which discharges through the small rectangular opening at the base of the control tower. This mud gate is scheduled to be replaced in 1979.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No design data for the original dam were located and none are believed to exist. However, six drawings showing proposed details of the 1924 repairs are available.

2.2 Construction Data

Six drawings showing details of the 1924 repairs are the earliest construction data available for this dam. Recent construction since 1975 is well documented by engineering drawings and photographs.

2.3 Operation Data

The only available operation data are water supply levels recorded on a daily basis.

2.4 Evaluation of Data

a. Availability. A list of engineering data available for use in preparing this report is included on page B-1 and B-2. Selected documents from the listing are also included in Appendix B.

b. Adequacy. There was a considerable amount of engineering data available to aid in the evaluation of Snows Mill Pond Dam. A review of these data in combination with visual examination, approximate hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement, was adequate for the purposes of a Phase I assessment.

c. Validity. There was no reason to doubt the validity of the available engineering data.

SECTION 3 - VISUAL EXAMINATION

3.1 Findings

a. General. The Phase I visual examination of Snows Mill Pond Dam was conducted on 16 November 1978.

In general, the project was found to be in good condition. However, deficiencies which require further engineering investigation necessitate an overall condition rating of fair.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. The main earth embankment associated with the dam is a dike located left of the control tower along the riverbank, shown in Photo No. 2. There was no evidence of settlement, lateral movement or other serious defects. Slight seepage was evident, but it is understood to be a long-standing condition.

The following specific items concerning the dike embankment were noted:

1. The embankment crest and slopes, Photos No. 2 and 3, are generally grass-covered. Some low brush growth and local areas of minor surface erosion were noted on the upstream slope.

2. The stone masonry walls supporting a portion of the downstream face of the dike embankment are generally in good condition, Photo No. 4. Clear running water was noted seeping under the lower stone wall at the location of Photo No. 5. The rate of flow was estimated at 1/2 gpm, causing the surrounding area to be soft and wet. No indication of piping was observed.

The shoreline of the river upstream of the right abutment is grass-covered and well maintained, Photo No. 7. A stone wall near the waterline supports some of the shore. A stone masonry wall also supports a short length of the riverbank immediately downstream of the right gatehouse. Surface runoff from the plant roadway and discharge from a 12-in. V.C. pipe has caused a small eroded

area to form near the wall, left side of Photo No. 6. This condition does not cause concern for the right abutment at this time.

c. Appurtenant Structures. The concrete-capped stone masonry spillway shown in Photo No. 6 is in excellent to good condition, with some minor efflorescence and staining observed along the length of the spillway cap. There are medium sized voids in the stone masonry at the bottom of the east wall, Photo No. 8, and minor voids in the stone masonry face of the south and west walls of the spillway, Photos No. 9, 10, 11 and 12. Minor seepage was noted at the voids in the east wall approximately 6 ft. from the south end. Minor seepage at the bottom of the south wall at about the mid-point of the wall, Photo No. 9, and the intersection of the south and west spillway walls, Photo No. 10, is clearly delineated by the greenish stain on the stone masonry, the pools of water at the wall base which have a very slow flow and the reddish-brown material at the bottom of the south wall. There was also some very minor seepage observed at one location in the stone masonry of the west spillway wall about half way down from the top.

The control tower to the left of the spillway, Photos No. 2 and 13, is in good to excellent condition and appears to have recently received extensive repairs and cosmetic work. Minor efflorescence was observed throughout the exterior surface of the superstructure. The substructure of the gatehouse showed minor efflorescence and erosion of concrete. There were three gate operators observed with identification signs on the walls behind them, Photo No. 14. The left gate supplies the filters, central steam plant and No. 6 Mill. The middle gate supplies the hydroelectric generating station downstream of the dam. The right gate is for the pond drain and was opened during the inspection. A conduit at the bottom of the gatehouse is reportedly closed off with a mud gate, Photo No. 15. Flow was observed through this conduit and exiting at the base of the control tower.

The exterior of the gatehouse to the right of the spillway, Photo No. 7, is in good condition. Some minor efflorescence was observed on the walls. The wooden stairs leading to the operating floor and the wooden deck over the intake shaft are in poor condition. It appears that the inside of the structure has not been maintained for some time.

The general condition of the upstream training walls, Photos No. 2 and 7, is good. There was some minor efflorescence observed on the right wall and heavier efflorescence observed on the left training wall.

d. Reservoir Area. Snows Mill Pond is bordered by several homes along Route 2A (Westminster Street) on the left side and the dam owner's Mill No. 8 building and parking lots on the right side. The terrain of this developed area is relatively flat. The shoreline is generally grass-covered with occasional trees, apparently well maintained. There is no significant probability of landslides into the reservoir affecting the safety of the dam. Sedimentation has apparently not been a problem at the dam site, since the timber-crib cofferdam immediately upstream of the dam is a barrier.

e. Downstream Channel. The Whitman River has a length of about 1,500 feet from the dam to the confluence with Flag Brook. The width of the river channel varies from approximately 100 ft. near the dam to about 60 ft. where an existing mill building abuts the channel. Based on information obtained from the USGS Fitchburg quadrangle map, the bedrock channel bottom has relatively steep slopes varying from 2.5 percent to about 20 percent (see profile, page D-8). Some large boulders within the channel were observed near the dam, Photo No. 17. Several mill buildings are located on both banks of the river. There are two important crossings over the river within the downstream reach: (a) a timber bridge at the upper mills, and (b) a stone arch culvert under Route 31.

The general condition of the concrete wall on the left side of the downstream channel is in good to fair condition. A large number of small cracks with efflorescence were observed along the wall, Photo No. 15. The concrete at the bottom of the wall is cracked and spalled off at several locations along the upstream half of the wall. Reinforcement can be seen in one of the spalled areas which is located about halfway down the length of the wall, Photo No. 16.

3.2 Evaluation

Based on the visual examination, the dike embankment, the spillway and other appurtenant structures are generally in good condition, except for the deficiencies noted in the stone masonry walls, the right gatehouse and the concrete wall on the left side of the downstream channel. However, there is a need for additional engineering investigation to assess the ability of the earth dike to withstand overtopping and to evaluate the noted seepage. Therefore, the overall condition of Snows Mill Pond Dam is considered to be fair.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

In general, there are no written, formal procedures used to maintain and operate the dam. However, the owner's Chief Engineer, Mr. Collette, is responsible for determining and implementing maintenance work required for the satisfactory operation of the dam.

4.2 Maintenance of Dam

The dam is periodically examined by Mr. Collette throughout the year on an informal basis.

Any required major maintenance work is scheduled to be performed during the annual one-week shutdown in July when the pond is drained. Routine maintenance of the embankment slopes is provided by the owner on an as-required basis.

4.3 Maintenance of Operating Facilities

The facility, in general, is well maintained because the impounded water supply is critical to the operation of the mill. The owner has an improvement and repair schedule established through 1979, page B-24, which includes replacement of the mud gate. The intake for the old No. 2 mill through the right gatehouse has been abandoned and blocked up with concrete. It appears that little to no maintenance has been performed at the gatehouse since that time.

4.4 Description of any Warning System in Effect

There is no warning system or formal emergency preparedness plan in effect for this structure. In the event of an emergency, the operator stated that he would close the gate in the next pond upstream of the dam and attempt to drain Snows Mill Pond through the regulating outlet.

4.5 Evaluation

The owner should prepare an operation and maintenance manual for the dam. The manual should delineate the routine operational procedures and maintenance work to be done on the dam to provide satisfactory operation and minimize deterioration of the facility. Since failure of the dam

would probably cause loss of life and extensive property damage downstream, the owner should also prepare a formal emergency preparedness plan and warning system.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Construction of a dam in Whitmanville, about 3.3 miles upstream of the Snows Mill Pond Dam, has been proposed by the Corps of Engineers as part of a flood control project for the basin. There are five other existing reservoirs within the upstream section of the discharge area. The following excerpts, which were taken from the 1965 report of the Corps of Engineers, explain general hydrological characteristics of the area:

"Although there are several reservoirs and ponds in the watershed, they are maintained at nearly constant levels and contain only minor surcharge-storage, so that there is little modification of peak flows during moderate and large floods."

"The North Nashua River and tributaries above Leominster are relatively steep and contain only a minor amount of valley storage. Consequently, the period of flooding is nearly coincident with the duration of the storm. During past floods, the water levels have risen and receded rapidly, so that, the damage has resulted primarily from high velocity flow rather than from extended periods of inundation."

The spillway portion of the Snows Mill Pond Dam is located at the deepest section of the channel and is made of large stone blocks with a concrete capping at the top. The dike embankment along the left bank has a shallower depth than the spillway area and is protected by a concrete wall. A submerged cofferdam remaining from construction is located about 130 ft. upstream of the spillway.

b. Design Data. No hydrologic or hydraulic design data were available for this dam site.

c. Experience Data. Major floods of the North Nashua River, to which the Whitman River is a tributary, were studied by the Corps of Engineers in the past. The following peak flows at the downstream end of the Whitman River were synthesized based on records at the gage in Leominster and in other similar watersheds.

Date	Discharge (cfs)
18 March 1936	5,650
21 September 1938	4,400
15 October 1955	4,200

The Massachusetts Geodetic Survey recorded a high water of 3.1 ft. above crest of the spillway at the Snows Mill Pond Dam on 18 March 1936. A freeboard of 1.9 ft. would be available if that flood were to occur now. During the same storm, the water level was 2.4 ft. above the road surface at the Route 31 culvert, and a strip of land along the road about 1,500 ft. long in the northeast direction from the culvert was flooded.

d. Visual Observations. Water level in the pond during the field inspection on 16 November 1978 was at the crest of the spillway, but there was no flow over the spillway. The owners reportedly attempt to maintain this level to meet suction head requirements of a water supply pump. The 1936 flood level, the highest ever recorded, was marked with a plaque on the left sidewall of the spillway. The control tower on the left bank, which accommodates valves for the pipe outlets, is well maintained.

Several large size granite blocks are present in the stilling basin of the spillway. The left bank, downstream of the spillway, is protected by a concrete wall about 12 ft. high. The right bank extends to the access road of the owner's factory with relatively steep slope. Large boulders and scattered young trees were observed on this bank.

e. Test Flood Analysis. Based upon the Corps of Engineers guidelines, the recommended test flood for the size "small" and the hazard potential "high" is within a range of 1/2 PMF to PMF (Probable Maximum Flood). The PMF was determined using Corps of Engineers guidelines for "Estimating Maximum Probable Discharge" in Phase I Dam Safety Investigations. The watershed terrain was determined to be rolling with scattered steep hills, and an inflow rate of 1,400 cfs per square mile was selected for the drainage area of 27.5 square miles. The resulting PMF is 38,500 cfs.

Hydrograph Analysis for the Upper Nashua River Basin by the Corps of Engineers in 1965 indicated a Standard Project Flood flow of 11,500 cfs for the Whitman River basin. Considering this and also the degree of risk involved in the downstream area, a test flood equal to 1/2 PMF or 19,250 cfs was adopted for this investigation.

The existing five upstream reservoirs have a normal water surface area of about 500 acres. The maximum allowable overflow depths at the spillways of these reservoirs

vary from 5.5 ft. to 8.5 ft. The assumption of an average 4 ft. overflow at these spillways during a major flood would result in an approximate surcharge volume of 2,000 acre-ft. By utilization of the flood hydrographs developed for the Whitman River by the Corps of Engineers, a total runoff volume of 14,250 acre-ft. was estimated for 1/2 PMF. A test flood inflow of 16,600 cfs then was computed after adjusting the runoff volume for the surcharges in the upper reservoirs.

A surcharge-storage routing was performed through Snows Mill Pond using the related stage-discharge and area-volume curves which are shown in Appendix D. The test flood outflow, which was estimated to be 15,800 cfs, would overtop the dike by about 2 ft. The capacities of the piped outlets were ignored in this evaluation. A similar analysis, which was carried out for the Standard Project Flood of 11,500 cfs, indicated an overtopping of the dike by about 0.8 ft. of water. In conclusion, the spillway is inadequate to pass either the 1/2 PMF or the Standard Project Flood without overtopping.

f. Dam Failure Analysis. Based on Corps of Engineers Guidelines for Estimating Dam Failure Hydrographs and assuming that a failure would occur along a 120 ft. long section at the mid-height of the spillway, the peak failure outflow is estimated to be 12,000 cfs (assuming that the existing upstream timber-crib cofferdam would fail simultaneously). Two reaches were studied for the flood routing.

Storage volume of the first reach between the spillway and the Mill Bridge is negligible. Therefore, it can practially be assumed that the channel section underneath the bridge would have to pass a flood flow of 12,000 cfs. Capacity of the channel is estimated to be 23,000 cfs. Thus, the bridge is not expected to be overtopped by the flood flow from a failure.

The downstream channel gradient is relatively steep and the storage in the second reach, which extends to Route 31, is not significant either. The culvert underneath Route 31 has an estimated maximum capacity of about 8,500 cfs. Therefore, in the event of a failure at the spillway, Route 31 would be overtopped and the low lying areas north along the road would be flooded. About 4 homes and 5 manufacturing buildings would be affected in this area.

If failure occurred at the right abutment of the dike (adjacent to the control tower) an estimated flood flow of 1,500 cfs would be discharged into the parking lot and directed towards a mill building currently in

use, posing a potential loss of life to employees within the structure as well as damage to the structure. Water diverted by the presence of the structure would flow back into the river channel and/or flow along Route 2A (Westminster Street) to the North Nashua River. It is expected that some property damage would occur along Route 2A. Due to the potential loss of life and extensive property damage that would result from a failure of the dike, the hazard classification is considered high.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. There was no visual evidence of settlement, lateral movement or other signs of structural instability of the earth embankment and no visual evidence that movement or distress in the spillway has taken place. Minor seepage was noted, as discussed in Section 3, but there was no evidence of significant soil erosion or piping. Thus the seepage is not considered to effect the structural stability of the dam at this time.

b. Design and Construction Data. No original design and construction data were disclosed. Design data in the form of construction drawings for various repairs to the spillway and appurtenant structures are available. Due to the lack of original engineering data, the stability of the dam must be based primarily on the visual observations made during the site investigation. The present condition of the project after an estimated 60 or more years of operation indicates that the dam has demonstrated stability over a long period of time.

c. Operating Records. There were no operating records available to aid in the evaluation of structural stability.

d. Post-Construction Changes. The dike embankment and spillway were constructed prior to 1924. Review of available drawings indicates that the control tower and right gatehouse may have been constructed after the original construction, probably during the 1924 repairs. As described in Section 1.2h, there are indications that the walls adjacent to the spillway were either raised or replaced since 1924, but no further information is available. Such a modification would be pertinent to the structural stability of the dam. The spillway weir cap has been replaced since 1924, most recently in 1977.

e. Seismic Stability. Snows Mill Pond Dam is located in Seismic Zone 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination of Snows Mill Pond Dam revealed that the structure itself was generally in good condition. However, concern regarding the resistance of the earth dike to overtopping and the seepage at the dike and spillway walls necessitates an overall condition rating of fair. No signs of structural failure or other conditions which would warrant urgent remedial action were noted.

Based on the results of computations included in Appendix D and described in Section 5, the spillway is not capable of passing the test flood, which for this structure is the 1/2 PMF. The 1/2 PMF outflow of 15,800 cfs would overtop the dam by about 2 ft. With the water level at the top of the dam, the spillway capacity is 8,500 cfs, which is 54 percent of the test flood.

b. Adequacy of Information. This evaluation of the dam is based primarily on visual examination, approximate hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. Generally the information available or obtained was adequate for the purposes of a Phase I assessment. However, it is recommended that additional information regarding the seepage occurring through the stone masonry of the spillway and downstream face of the earth dike, as outlined in Section 7.2, be obtained.

c. Urgency. The recommendations for additional investigation and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be undertaken by the Owner and completed within one year after receipt of this report.

d. Need for Additional Investigation. Additional investigations should be performed by the Owner as outlined in Section 7.2.

7.2 Recommendations

It is recommended that the owner of the dam, James River Massachusetts, Inc., engage a registered professional engineer to undertake the following investigations, and implement corrective action as required:

1. Perform additional hydrologic studies to better define the overtopping potential at the earth dike, and then evaluate the stability and capacity of the dike to withstand the amount of overtopping predicted by this study.

2. Evaluate the seepage that is occurring at the base of the stone masonry wall on the downstream side of the dike and through the stone masonry of the spillway walls. The investigation should include the location, character and amount of seepage flow at times of high and low pond levels in an effort to determine the path of seepage and whether or not the seepage is changing with time.

7.3 Remedial Measures

Although the dam is generally in good condition, it is considered important that the following items be accomplished.

a. Operation and Maintenance Procedures. The following remedial work should be undertaken by the Owner:

1. Trim brush and repair minor surface erosion on the upstream side of the dike embankment. Consideration should be given to placing stone riprap to protect the shoreline in this area.

2. Replace missing and/or fallen stones in the voids of the stone masonry face of the spillway walls.

   While not critical to the safety of the dam, it would be desirable to repair and refurbish the concrete wall on the left side of the downstream channel, including the addition of weep holes.

3. Replace the stairs and secure the intake shaft opening to ensure safety at the right gatehouse.

The Owner should prepare an operation and maintenance manual for the dam. The manual should include provisions for biennial technical inspection of the dam and for 24-hr. surveillance of the dam during and after periods of

heavy precipitation and high river elevations. The surveillance is particularly important until such time as the seepage evaluation has been completed. The procedures should delineate the routine operation procedures and maintenance work to be done on the dam to ensure satisfactory operation and to minimize deterioration of the facility.

Because the dam is classified as having a "high" hazard potential, the owner should also develop a written emergency preparedness plan and warning system to be used in the event of impending failure of the dam. The plan should be developed in cooperation with local officials and downstream inhabitants.

7.4 Alternatives

In lieu of performing the remedial measures stated above for the right gatehouse, the superstructure could be removed and a permanent slab enclosure added over the intake shaft.

APPENDIX A - INSPECTION CHECK LIST

	Page
VISUAL INSPECTION PARTY ORGANIZATION	A-1
VISUAL INSPECTION CHECK LIST	
Dike Embankment	A-2
Outlet Works - Spillway Weir, Approach and Discharge Channels	A-3
Outlet Works - Control Tower	A-4
Outlet Works - Right Gatehouse	A-5

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

Dam: Snows Mill Pond

Date: 16 November 1978

Time: 1330-1545

Weather: Clear, cool (40-50°F)

Water Surface Elevation Upstream: El. 660.9 (0.1 ft. below spillway weir)

Stream Flow: None over dam

Inspection Party:

Richard P. Stulgis Richard A. Brown Haley & Aldrich, Inc.	- Soils/Geology
A. Ulvi Gulbey Joseph E. Downing	- Hydraulic/Hydrologic
Robert P. Howard Camp, Dresser & McKee, Inc.	- Structural/Mechanical

Present During Inspection:

Mr. Leo P. Collette, Jr., Chief Engineer
James River Massachusetts, Inc.
Mr. Francis Flanagan, Engineer
William T. Hill, Inc.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Snows Mill Pond Dam DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	El. 666 MSL (top of concrete training wall)
Current Pool Elevation	El. 660.9 (0.1 ft. below spillway weir)
Maximum Impoundment to Date	El. 664.1 during flood on 18 March 1936
Surface Cracks	None observed
Pavement Condition	Embankment is grass covered
Movement or Settlement of Crest	No indications observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Restricted by fence at left end, no indications of problem observed
Animal Burrows in Embankment	None observed
Vegetation on Embankment	Grass covered, with some brush growth on reservoir side
Sloughing or Erosion of Slopes or Abutments	Limited minor surface erosion on upstream side
Rock Slope Protection - Riprap Failures	None observed
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	Clear running water (estimated 1/2 gpm) seeping at base of downstream masonry wall. Reported to be long-standing condition by owner
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation Systems	None observed

FILE NO. 4160

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Snows Mill Pond Dam DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNEL	
a. Approach Channel	
General Condition	Not applicable, Z-shaped spillway is adjacent to pond
Loose Rock Overhanging Channel	Not applicable
Trees Overhanging Channel	Several large trees on right bank upstream of spillway
Floor of Approach Channel	Submerged, not visible
b. Weir and Training Walls	General condition of the spillway is good to excellent. The stone masonry face of the spillway is good. The face of the west spillway shows some voids in the stone masonry. There are minor voids in the south wall and medium size voids in the east spillway walls
General Condition of Concrete	The upstream concrete training walls and spillway cap are in good to excellent condition
Rust or Staining	Minor rust and staining observed
Spalling	No spalling observed
Any Visible Reinforcing	No visible reinforcing observed
Any Seepage or Efflorescence	Minor seepage from voids in east and west spillway walls, at the middle of the south spillway wall and at the intersection of the south and west spillway walls. Minor efflorescence observed at the spillway cap and right training walls. Heavy efflorescence at the left training walls
Drain Holes	No drains observed
c. Discharge Channel	
General Condition	Good

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Snows Mill Pond Dam DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	Right side of channel has some small trees and brush
Floor of Channel	Ledge and/or bedrock-floor with some minor rock rubble and minor vegetation
Other Obstructions	None observed
Channel Wall (left side)	The general condition of the concrete wall on left side is fair to good. There are many small cracks with efflorescence observed along the wall. The bottom of the wall is cracked and spalled off at several locations along the upstream half of the wall. At one of the spalled areas reinforcement can be seen. No weep holes observed
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	The general condition is good to excellent. It appears that remedial repairs have recently been made
Condition of Joints	Excellent
Spalling	None observed in the superstructure. Minor spalling observed in the substructure
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflo-resence	Minor efflorescence observed
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	Seepage observed at the lower mud gate conduit

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Snows Mill Pond Dam DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
Cracks	None observed
Rusting or Corrosion of Steel	None observed
Log Boom	Good
Trash Rack	Good
b. Mechanical and Electrical	
Air Vents	None observed
Float Wells	None observed
Crane Hoist	None observed
Elevator	None observed
Hydraulic System	None observed
Service Gates	There are three manually operated gates. Plates on the wall indicate one supplies the filters, central steam plant and the No. 6 mill. One supplies the penstock to hydro station and the third is for the pond drain, which was opened during the site visit
Emergency Gates	None other than pond drain
Lightning Protection System	None observed
Emergency Power System	None observed
Wiring and Lighting System in Gate Chamber	For interior lighting - ok
OUTLET WORKS - RIGHT GATE-HOUSE	
a. Concrete and Structural	
General Condition	The general condition of the structure is good to fair. The wooden stairway to the operating floor and the wooden decking over the intake shaft is in poor condition. It was stated by the

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Snows Mill Pond Dam DATE: 16 Nov. 78

AREA EVALUATED	CONDITION
General Condition (continued)	owner's representative that this structure is no longer in use
Condition of Joints	Good
Spalling	None observed
Visible Reinforcing	None observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	None observed
Rusting or Corrosion of Steel	None observed
b. Mechanical and Electrical	
Air Vents	None observed
Float Wells	None observed
Crane Hoist	None observed
Elevator	None observed
Hydraulic System	None observed
Service Gates	None observed - owner's representative indicated supply conduit to No. 2 mill blocked up with concrete
Emergency Gates	None observed
Lightning Protection System.	None observed
Emergency Power System	None observed
Wiring and Lighting System in Gate Chamber	None observed

APPENDIX B - ENGINEERING DATA

	Page
LIST OF AVAILABLE DATA	B-1
PRIOR INSPECTION REPORTS	
County Identification Card, Dam No. 16-16	B-3

Date	By	Page
9 October 1924	Worcester County Engineer	B-4
6 October 1938	Worcester County Engineer	B-5
6 January 1939	Worcester County Engineer	B-6
17 November 1943	Worcester County Engineer	B-7
15 October 1955	Worcester County Engineer	B-8
9 November 1964	Worcester County Engineer	B-9
8 April 1975	Mass. Department of Environmental Engineering	B-10

DRAWINGS	
Plan of Dam and Gatehouse, H.M. Haven & A.T. Hopkins, Inc., 16 September 1924	B-19
Repairs to Masonry Dam, Howard M. Turner, 29 October 1924	B-20
Dam Cap Plan and Sections, Drawing No. 8-0-433, William T. Hill, Inc., 7 July 1977	B-21
Gatehouse (Control Tower) Plan and Sections, Drawing No. 8-0-438, William T. Hill, Inc., 13 June 1977	B-22
Retaining Wall (Dike Wall) Plan and Elevation, Drawing No. 8-0-450, William T. Hill, Inc., 14 August 1978	B-23
DOCUMENT	
Snows Mill Pond Dam, 1978 Improvements and Proposed 1979 Improvements, James River Massachusetts, Inc.	B-24

LIST OF AVAILABLE DATA
SNOWS MILL POND DAM

Document	Contents	Location
"Plan of Dam and Gatehouse," H.M. Haven & A.T. Hopkins, Inc., Boston, MA, 16 September 1924	Five drawings showing plans, sections, elevations and details of the dam and gatehouse for the 1924 repairs	Office of the County Engineer, Room 101, Court House, 2 Main Street, Worcester, MA 01608 and page B-19
"Repairs to Masonry Dam," Howard M. Turner, Consulting Engineer, Boston, MA, 29 October 1924	Section through dam, crest of dam and coffer-dam for the 1924 repairs	James River Massachusetts, Inc., Fitchburg, MA 01420 and page B-20
County inspection reports from 1924 through 1970	Reports of the inspections in 1924, 1926, 1928, 1930, 1932, 1935, 1938, 1939, 1943, 1946, 1949, 1952, 1954, 1955, 1958, 1960 and 1964	Office of the County Engineer, and page B-3
State Inspection reports after 1970	8 April 1975 inspection report including description of dam and sketch	Mass. Dept. of Environmental Quality Engineering, 100 Nashua St., Boston, MA and page B-10
Drawing No. 8-0-433, William T. Hill, Inc., Dalton, MA, 7 July 1977	Dam Cap (spillway weir) plan and sections	James River Massachusetts, Inc., and page B-21
Drawing No. 8-0-438, William T. Hill, Inc., Dalton, MA, 13 June 1977	Gatehouse (control tower) existing before repairs,	James River, Massachusetts, Inc., and page B-22

LIST OF AVAILABLE DATA
SNOWS MILL POND DAM (continued)

Document	Contents	Location
Drawing No. 8-0-439, William T. Hill, Inc., Dalton, MA, 29 June 1977	Gatehouse (control tower) floor and wall modifications and new gate installation	James River Massachusetts, Inc.
Set of 46 photographs, James River Massachusetts, Inc., July 1977	Record of 1977 repairs to the spillway and control tower with pond drawn down	James River Massachusetts, Inc.
Drawing No. 8-0-405, William T. Hill, Inc., Dalton, MA, 14 August 1978	Retaining wall (dike wall) plan and elevation	James River Massachusetts, Inc., and page B-23
Snows Mill Pond Dam, 1978 Improvements and Proposed 1979 Improvements	Repairs made during annual one-week drawdown of pond in July	James River Massachusetts, Inc., and page B-24

TOWN OR CITY *Fitchburg* DECREE NO. PLAN NO. DAM NO. **16-16**

LOCATION *Snow Mill Pond - Gardner Road near Wachusett R R Station* C. C. DOCKET NO.

DESCRIPTION OF DAM

Type *Vert. Stone Wall - Earth fill. New Conc. Walls + Gates.*
Length *317'±*
Height *Total height 26'± At Spillway 25'±*
Thickness top *Emb. Wall - 14' Spillway 1.33*
" bottom *30'*
Downstream Slope *Vertical.*
Upstream " *About 1½ : 1*
Length of Spillway *215'±*
Size of Gates *Also 4'6" x 4'-6" (2) Pipe to Power - 7'-6"*
Location of Gates *North end of Dam.*
Flashboards used *None*
Width Flashboards or Gates
Dam designed by *New Gate Chamber } H M Haven & Waterproofing } A T. Hopkins, Inc. Boston*
"reconstructed by *Wiley & Foss - Contractors - Fitchburg*
Year constructed

GENERAL REMARKS

Owner: Crocker Burbank & Co. Assn.

1936 Flood El. 664.4 3.1 over Spillway
1938 Flood 3' over Crest.
Traced: March 15, 1940 - E.C. Corcoran } *Plans in*
Checked: " 21, " - L.O. Marden } *C.C. file*

DESCRIPTION OF RESERVOIR & WATERSHED

Name of Main Stream *Branch Whitman River*
" " any other Streams *Round Meadow Pond*
Length of Watershed
Width " "
% Watershed Cultivated
Percent in Forests
Steepness of Slope *Medium*
Kind of Soil *Solid ledge*
No. of Acres in Watershed *27.90 Sq M*
" " " Reservoir *38.27*

GENERAL REMARKS

Inspected: Oct. 9, 1924 - L. O. Marden
Dec. 14, 1926 - " "
Jan. 19, 1928 - " "
Nov. 26, 1930 - " "
Jan. 25, 1932 - " "
Nov. 2, 1935 - " "
Jan. 6, 1937 - L. H. Spofford
Oct. 6, 1938 - E. C. Corcoran

Decree No. Dam No. 16-16

COUNTY OF WORCESTER, MASSACHUSETTS

OFFICE OF COUNTY ENGINEER

Neg. Nos.

INSPECTION OF DAMS, RESERVOIR DAMS AND RESERVOIRS

Town Fitchburg Date Oct. 9, 1924 Dam No.

Location on Gardner Road Name of Pond or Stream Snow mill pond

Inspected by L. C. Worden

Owner Crocker Burbank Co. Use Paper making

MATERIAL & TYPE Vert. loose wall earth fill timber rave and gate chamber

Elevations in feet: above (+) or below (-) full pond or reservoir level.

FOR DAM Bed of stream below 61 top of spillway 100

FOR RESERVOIR

top of dam top of flashboards ground surface below

level of overflow pipe 88+ length in feet 215

width top in feet width bottom in feet size pipe to mill 6"?

inches length spillway in feet head in feet

Size of wheel H. P. developed

Size of gates location of gates

Foundation and details of construction solid ledge vert. loose laid walls in waste section condition of embankment

Reconstructed by

Constructed by Wiley and Foss Contractors date

Designed by Fitchburg location

Recent repairs and date now being repaired

Evidence of leakage thru gate cahamber

Condition later report

Topography of country below valley - steep slope

Nature of buildings and roads below dam mill-dam-houses and city

No. Acres in watershed No. Acres in pond

Plans secured Percent watershed in cultivation

Percent in forests Note: Cross out word not applicable

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by E. C. Corcoran Date 10/6/38 Dam No. 16-16

Town Fitchburg Location Shaw Mill Pond

Owner Crocker Burbank Co Use Yes (Paper Making)

Material and Type Cement + Stone

Dam Designed by Haven + Hopkins Constructed by C. B & Co Year 1924

SPILLWAY Water 3' over crest during flood None at present

El. top Abutment 624.0 El. Crest 4' below Abt. El. Apron El. Streambed 620.0

Width top Abutment 1.5 Width top Crest 1 ft Width bottom Spillway

Width Flashboards carried None Kind Flashboards None

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway Ledge

Condition Very Good

EMBANKMENT

El. Top 624.0 El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Good

GATES Location

Size Kind El. Flowline

Condition

Gates closed during flood

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs. Light Rain

Inspected by L H Spafford Date 11/6/39 1:30 P.M. Dam No. 16-14

Town Fitchburg Location Snows Mill Pond

Owner Use Power.

Material and Type Heavy Masonry Dam with concrete crest.

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition O.K. Water is barely trickling over top - Water wheels in use Screens clean of trash and in satisfactory condition.

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Good - about 200 ft of sand top still in place

GATES Location In Gate House

Size Kind El. Flowline

Condition Appear to be O.K.

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.M. - Rendell Date 11-17-43 Dam No. 16-12

Town Fitchburg Location Snows Mill Pond

Owner Crocker - Burbank Co. Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Ok - Raised concrete abt since 1938 about 30' - 12" wide - increased capacity spillway

EMBANKMENT

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Ok

GATES Location

Size Kind El. Flowline

Condition Ok

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None visible

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

TOWN Fitchburg — Heavy Rains — DAM NO. 16-16

LOCATION Snows Mill Pond — STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT

High Water — WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Cracker-Barbour Co PLACE Fitchburg USE Storage

INSPECTED BY L.A.M. - S. Fox DATE Oct. 15, 1955

TYPE OF DAM Earth Concrete CONDITION appear good

SPILLWAY

FLASHBOARDS IN PLACE None RECENT REPAIRS None

CONDITION Appear Good - Abt. 15" freeboard

REPAIRS NEEDED

EMBANKMENT

RECENT REPAIRS None

CONDITION appears OK

REPAIRS NEEDED None

GATES

RECENT REPAIRS Appear OK

CONDITION

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

COUNTY ENGINEER

TOWN [illegible] DAM NO. [illegible]

LOCATION [illegible] STREAM [illegible]

- ½ mile from the Westminster Town Line. "Snow Mill Pond"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by Weyerhaeuser Co. Inc. Place Fitchburg Use Mill Pond

Inspected by [illegible] Date Nov. 9, 1964

Type of Dam Earth, stone & concrete. Condition Good

SPILLWAY

Flashboards in Place No boards Recent Repairs _____

Condition Good A new concrete cap was built on this

Repairs Needed spillway in 1960

The present water elevation is about 5'

EMBANKMENT

Recent Repairs _____

Condition Good

Repairs Needed _____

GATES

Recent Repairs _____

Condition Good

Repairs Needed The gate house was rebuilt in 1962

LEAKS

How Serious No leaks

DATE: _____ County Engineer

May 3, 1975

Mr. William Baker
Water Control Division
Weyerhaeuser Co., Paper Division
545 Westminster Street
Fitchburg, Massachusetts

RE: Inspection-Dam #3-14-97-16
Fitchburg
Snow Mill Pond Dam

Dear Mr. Baker:

On April 8, 1975, an engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate that this dam is owned by Weyerhaeuser Company. Will you please notify this office if this information is not current.

The inspection was made in accordance with Chapter 253 of the Massachusetts General Laws, as amended by Chapter 595 of the Acts of 1970 (Dams-Safety Act).

The results of the inspection indicate that this dam is safe; however, the following conditions were noted that require attention:

1. Remove the growth of brush and trees from the upstream embankment of the dam.

2. There are some areas of minor seepage and a few pools of standing water at the downstream toe. This condition appears to be of long standing and should be checked periodically and corrective action taken when any change of condition is noted.

3. Due to the sheet flow at the spillway it was not possible to check the condition of the dam under this discharge. It is suggested that you conduct an inspection during the period of low flow and take whatever action may be necessary to correct deficiencies.

We call these conditions to your attention now before they become serious and more expensive to correct. With any correspondence, please include the number of the dam as indicated above.

Very truly yours,

Norman L. Diegoli WES
NORMAN L. DIEGOLI, P.E.
Acting Deputy Chief Engineer

LMA:jmp
cc: J. J. Lyons
W. Regan

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/~~Town~~ Fitchburg Dam No. 3-14-97-16

Name of Dam Snow Mill Pond Inspected by Regan, Rizzarella Miele

Date of Inspection 4/8/75

2. Owner/s: per: Assessors _____ Prev. Inspection _____

Reg. of Deeds _____ Pers. Contact _____

1. Weyerhaeuser Co., Paper Div. 545 Westminster St. Fitchburg, MASS 343-3051
Name Att:) St. & No. City/Town State Tel. No.

2. Bill BAKER - WATER Control Division
Name St. & No. City/Town State Tel. No.

3. _____
Name St. & No. City/Town State Tel. No.

3. Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name: St. & No.:

City/Town: State: Tel.No.:

4. No. of Pictures taken _____

5. Degree of Hazard: (if dam should fail completely)*

1. Minor _____ 2. Moderate ✓

3. Severe _____ 4. Disastrous _____

* This rating may change as land use changes (future development)

6. Outlet Control: Automatic _____ Manual ✓

Operative _____ yes; ✓ No.

Comments: Given the Size of the impoundment, a 42" DIA Gated outlet (Processing Water) wouldnt Appear Capable of Affecting Upper Pool Level Significantly

7. Upstream Face of Dam: Condition:

1. Good _____ 2. Minor Repairs ✓

3. Major Repairs ___ 4. Urgent Repairs ___

Comments: Remove Trees & Brush

8. Downstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs ✓

3. Major Repairs ____ 4. Urgent Repairs _____

Comments: Very Minor leakage in d.s. masonry @ drop Spillway, Leakage evidenced in Earth Dike Portion by Small Amount of water standing @ downstream Toe.

9. ~~Emergency~~ Principal Spillway

Condition: 1. Good ✓ 2. Minor Repairs _____

3. ~~Major Repairs~~ ____ 4. Urgent Repairs _____

Comments: except for minor Leakage through d.s. Vertical Face

10. Water Level at time of inspection: 0.1± ft. above ✓ below ____

top of dam _____ principal spillway Crest

other _____

11. Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment ✓

Animal Burrows and Washouts None Noted

Damage to slopes or top of dam None Noted

Cracked ~~or Damaged~~ Masonry minor @ Gate House Approach Walls

Evidence of Seepage ✓ @ d.s. Toe Earthen dike Portion

Evidence of Piping —

Erosion —

Leaks Very minor Leakage @ D.S. masonry Face (drop Spillway)

Trash and/or debis impeding flow None Noted

Clogged or blocked spillway " "

Other _____

12. Remarks & Recommendations: (Fully Explain)

There appears to be nothing really outstandingly wrong with this dam. There is minor leakage through the d.s. Vert. masonry face of the drop Spillway and the seepage through the earthen dike (with Conc. Corewall) is minor, the only evidence of same being a few small pools of standing water at the d.s. Toe. Seepage through the Vertical d.s. face of the drop Spillway was hard to evaluate (As to degree) because the flow over the drop Spillway tends to keep the surface both saturated & obscured from view.

Because of the above mentioned limitations with regard to visual investigation under these circumstances, because of the moderate d.s. hazard, because of the age and size of this dam, (making the central portion virtually inaccessable to inspection) it would probably be desireable to have the Vert. d.s. masonry face of this dam given a thorough inspection by a Consultant. Possibly portions of the approach apron could be alternately bagged off in order to keep a more or less normal head on the U.S. (or fill) side of the Vert. masonry drop Spillway wall. The d.s. vert. face could then be inspected for leakage, seepage, general structural cond. etc.

13. Overall Condition:

1. Safe _____
2. Minor repairs needed ✓ So far as it could be determined by a visual inspection
3. Conditionally safe - major repairs needed _____
4. Unsafe _____
5. Reservoir impoundment no longer exists (explain)

   Recommend removal from inspection list _____

DESCRIPTION OF DAM

DISTRICT 3

Submitted by W. REGAN, R. RIVALLA Dam No. 3-14-97-16

Date 4/16/75 City/~~Town~~ Fitchburg

Name of Dam SNOW MILL POND

1. Location: Topo Sheet No. 19D

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year built: N/A - Pre 1924 Year/s of subsequent repairs Some 1940

3. Purpose of Dam: Water Supply _____ Recreational _____

Irrigation _____ Other MILL DAM (Active)

4. Drainage Area: 28± sq. mi. _____ acres

5. Normal Ponding Area: 38± acres; Ave. depth N/A

Impoundment: _____ gals.; _____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir 2 large Mill Buildings, Numerous Sheds i.e. summer homes, etc. 2 Residences

7. Dimensions of Dam: Length _____ Max. Height _____

Slopes: Upstream Face Vertical Approx 1½ : 1

Downstream Face Vertical

Width across top See Sketches

8. Classification of Dam by Material:

Earth ✓ Conc. Masonry ✓ Stone Masonry ✓

Timber _____ Rockfill _____ Other _____

9. A. Description of present land usage downstream of dam:

_____% rural; 100 % urban.

B. Is there a storage area or flood plain downstream of dam which could accomodate the impoundment in the event of a complete dam failure? yes _____ no ✓.

DAM NO. 3-14-97-16

*10. Risk to life and property in event of complete failure.

No. of people _____.

No. of homes _____.

No. of Businesses _____.

No. of industries _____. Type _____

No. of utilities _____. Type _____

Railroads _____.

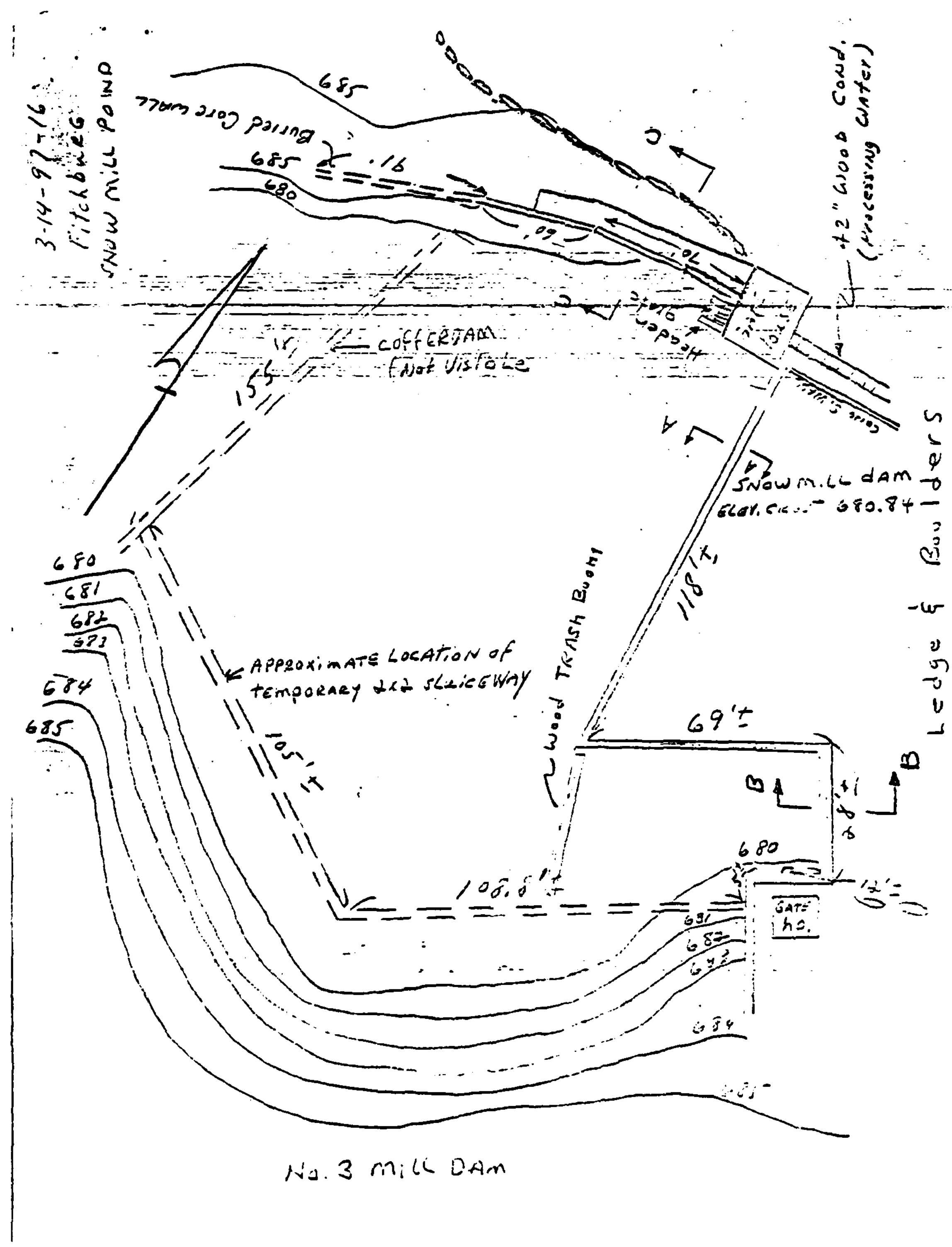
Other dams _____.

Other _____.

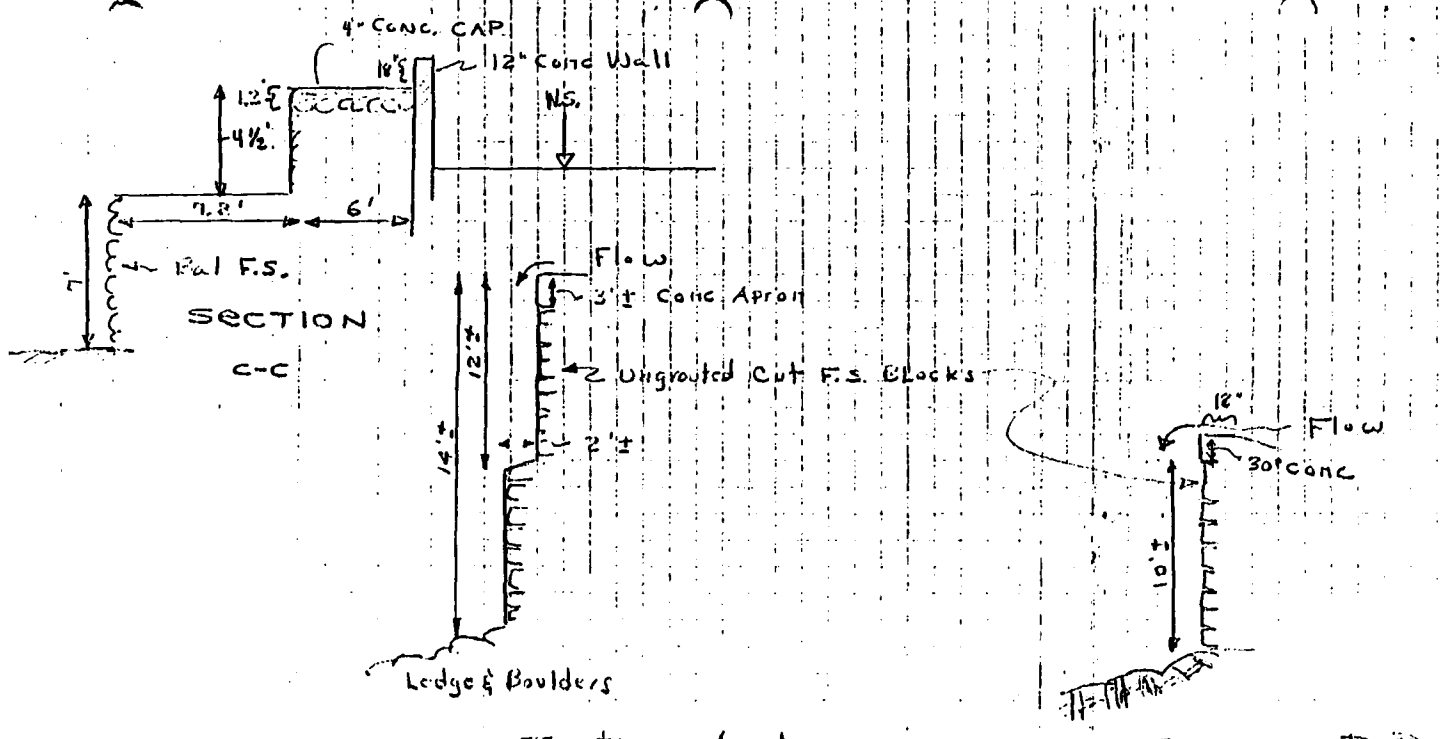
11. Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

12. How to Locate: W.B. on Rte. 2A - 31 overlap, Turn Rt. onto Westminster St. DAM is LT. of Rd a few hundred Feet up Westminster St.

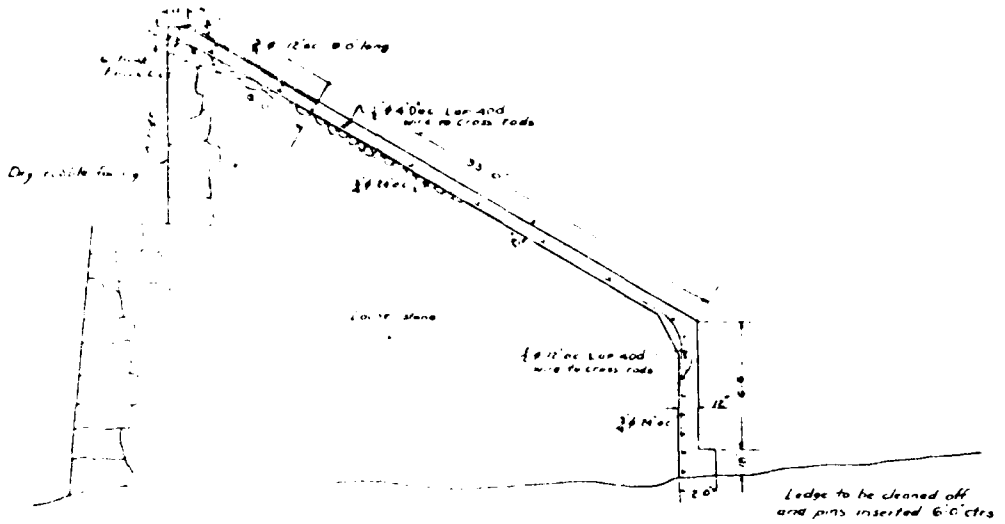
* Note (10): If The Earthen Embankment Breached, 2 mill Sheds, 1 mill Bldg, 10± Residences N. of Westminster St. & Several 1 Sty office Buildings & Rte 12 would be Flooded. Risk To Life light to moderate. If The Spillway Sect were to be breached, 2 mill Blds and Rte 12 would be flooded. Utilities on & Under Rte 12 would be Affected. DAM # 15 downstream has been Semi-breached IN That it is now ALmost All Spillway and only a few feet in height. Because it would immediately PASS All of The Discharge From dam 16, Property damage downstream is possible.



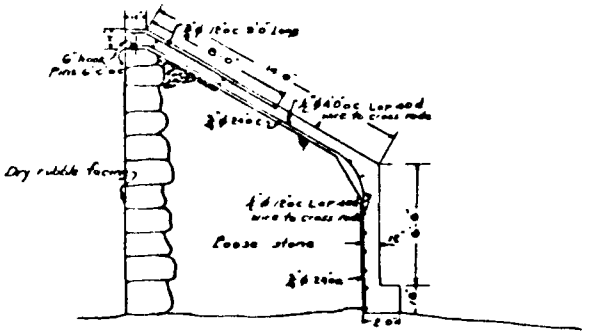
3-14-97-16
Fitchburg
SNOW MILL POND
685
Buried Core wall
685
680
.16
60'
70'
42" Wood Cond.
(processing water)
Header
COFFERDAM
(Not Visible)
155
A
A
SNOW MILL DAM
ELEV. CREST 680.84
Ledge & Boulders
118'±
Wood TRASH Boom
APPROXIMATE LOCATION of
temporary 2x2 SLUICEWAY
105'±
680
681
682
683
684
685
69'±
B
B
68'±
680
108.6'±
GATE
hs.
No. 3 Mill DAM


4" Conc. CAP
12" Conc Wall
N.S.
1.2'±
4½'
7.2'
6'
Pal F.S.
SECTION
C-C
Flow
3'± Conc Apron
Ungrouted Cut F.S. Blocks
12'±
14'±
2'±
Ledge & Boulders
Section A-A
12"
Flow
30° conc
10'±
SECTION B-B

B-18

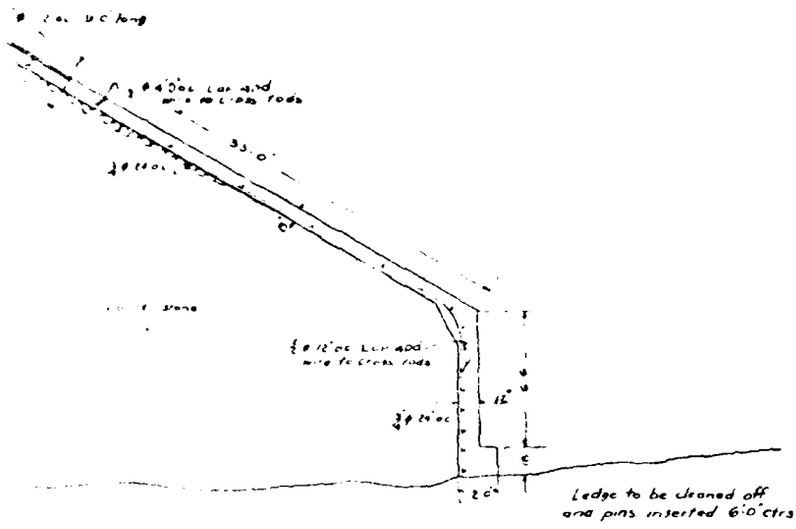


Section thru East Face of Dam

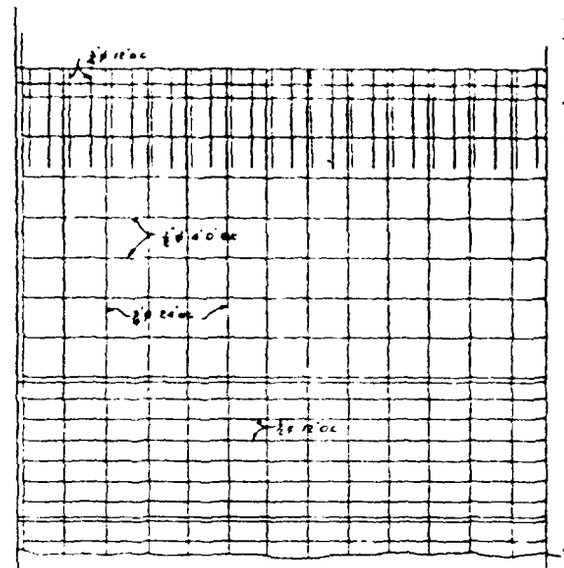


Section thru South Face of Dam

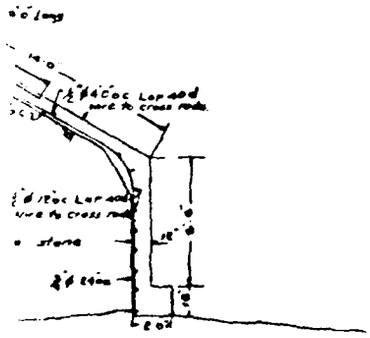
FILE NO 4270 811



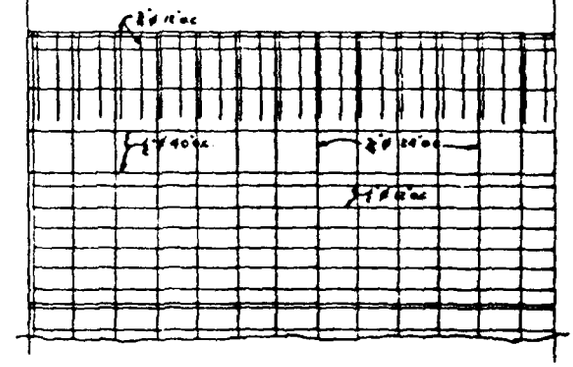
...tical thru East Face of Dam



Typical Elevation
East Face of Dam



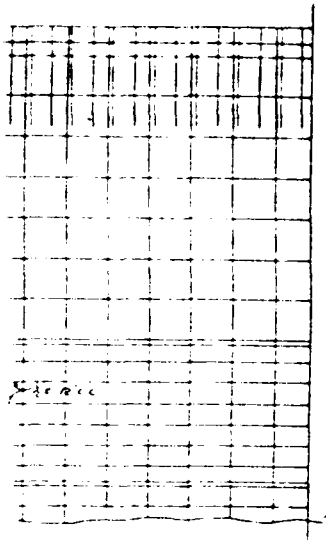
... South Face of Dam



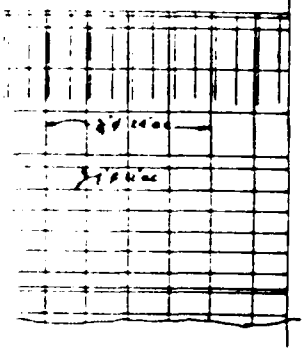
Typical Elevation
South Face of Dam

WATER PROOFING OF
NO. 3 MILL DAM & WING WALL

H. M. HAVEN & A. T. HOPKINS INC.
11 BEACON ST BOSTON MASS
SEPT 15, 1924



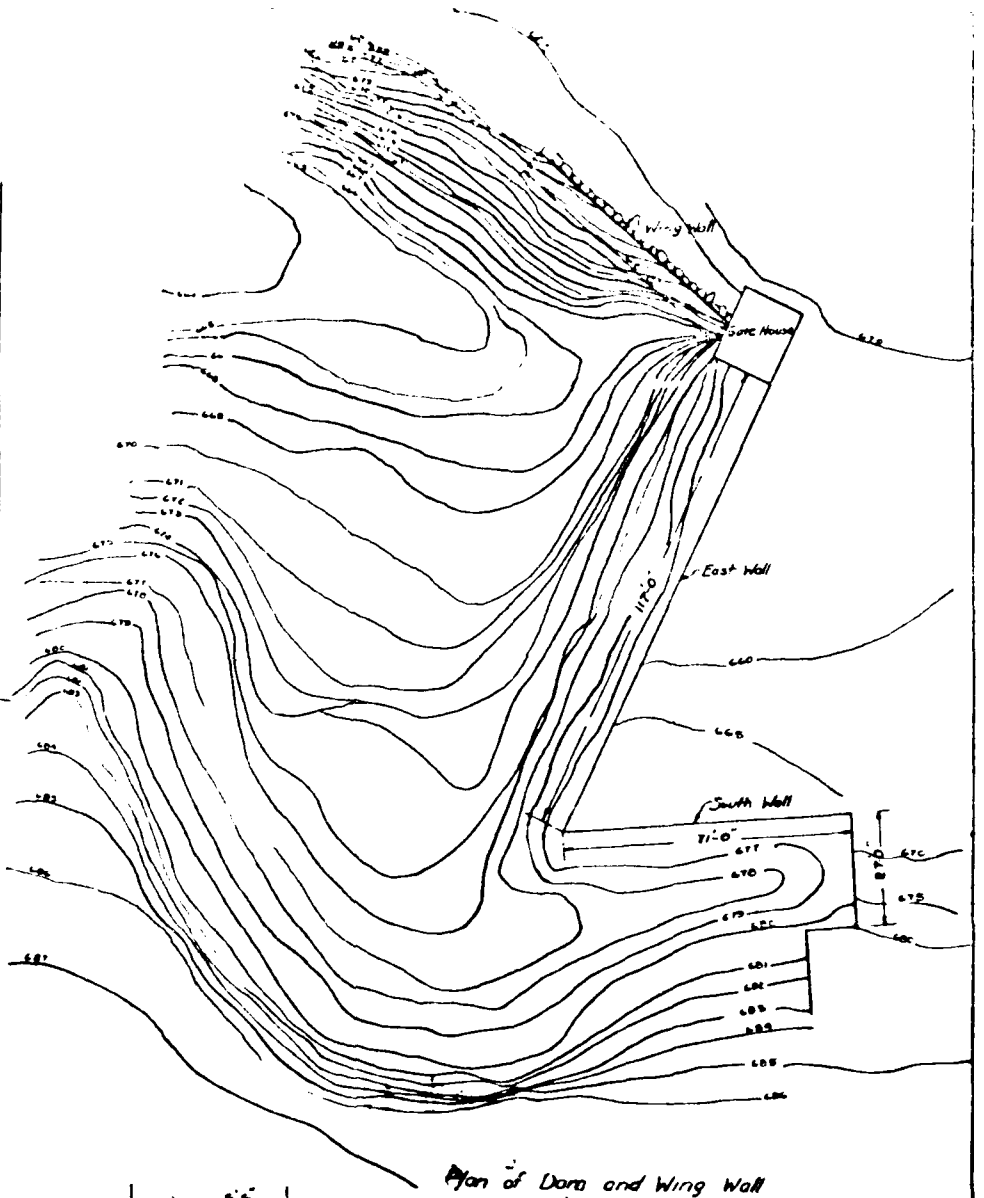
Face of Dam



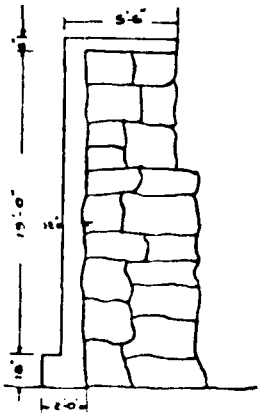
Face of Dam

WATER PROOFING OF
3 MILL DAM & WING WALL

M. HAVEN & A. T. HOPKINS INC.
BEACON ST BOSTON MASS
SEPT 16, 1924



Plan of Dam and Wing Wall
Scale 1"-20'-0"

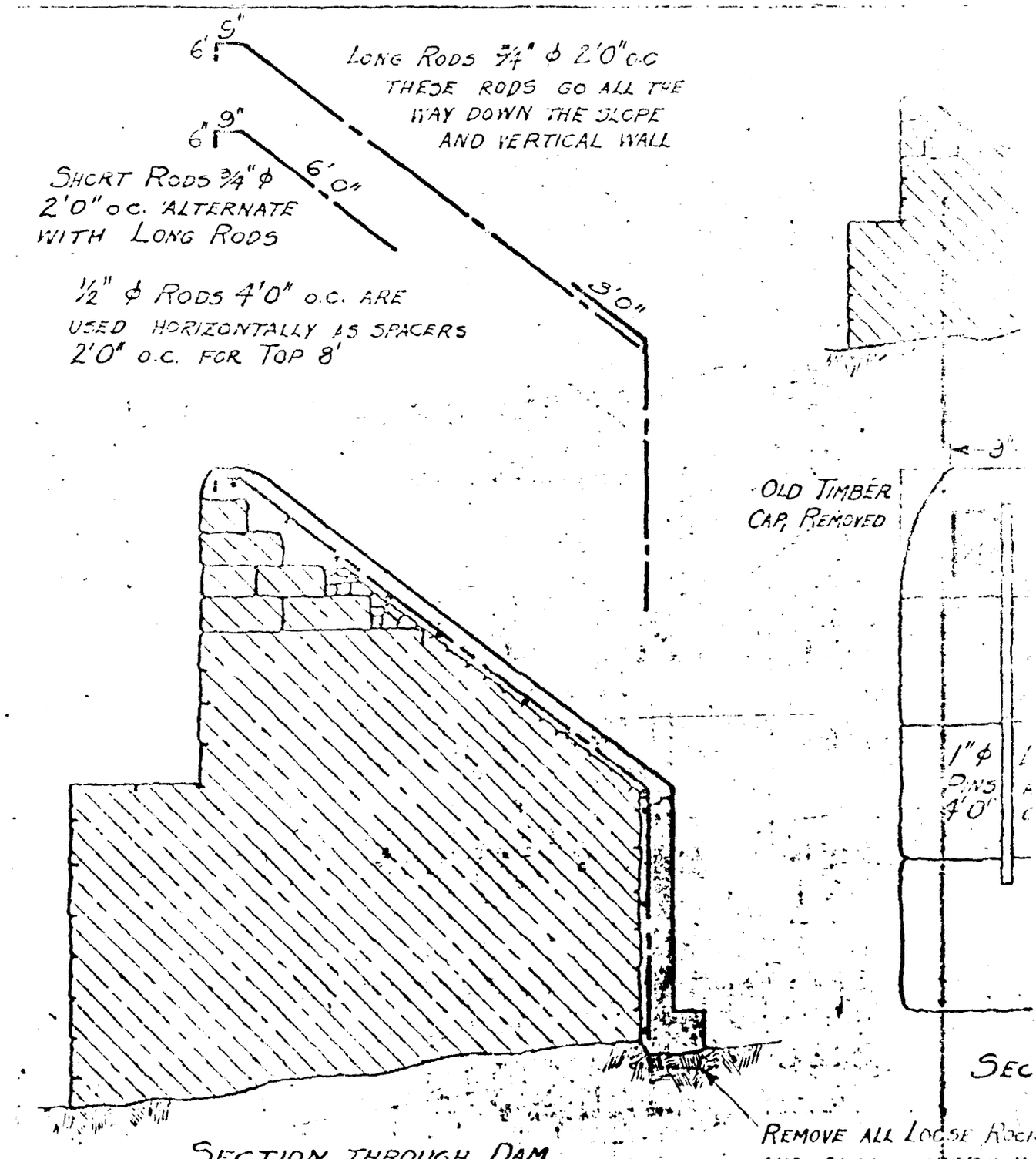


Section thru Wing Wall

WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
DAM AND GATEHOUSE
SNOW MILL POND
FITCHBURG, MASS.
FOR CROCKER BURBANK AND COMPANY INC.
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS

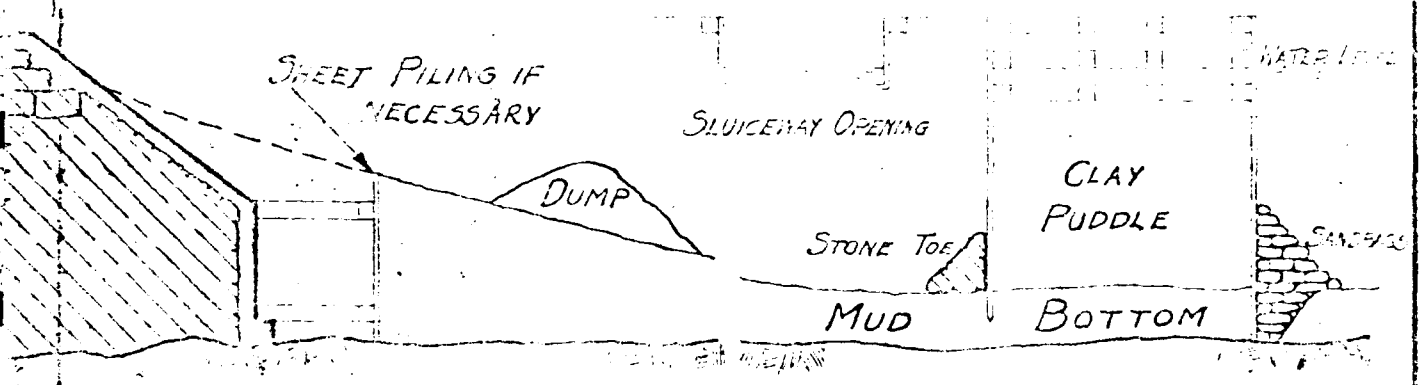
SCALES AS NOTED

TRACED BY E.F.C. March 18, 1940
TRACING CHECKED BY L.O.M. Mar. 21, 1940 DAM NO. 16-18

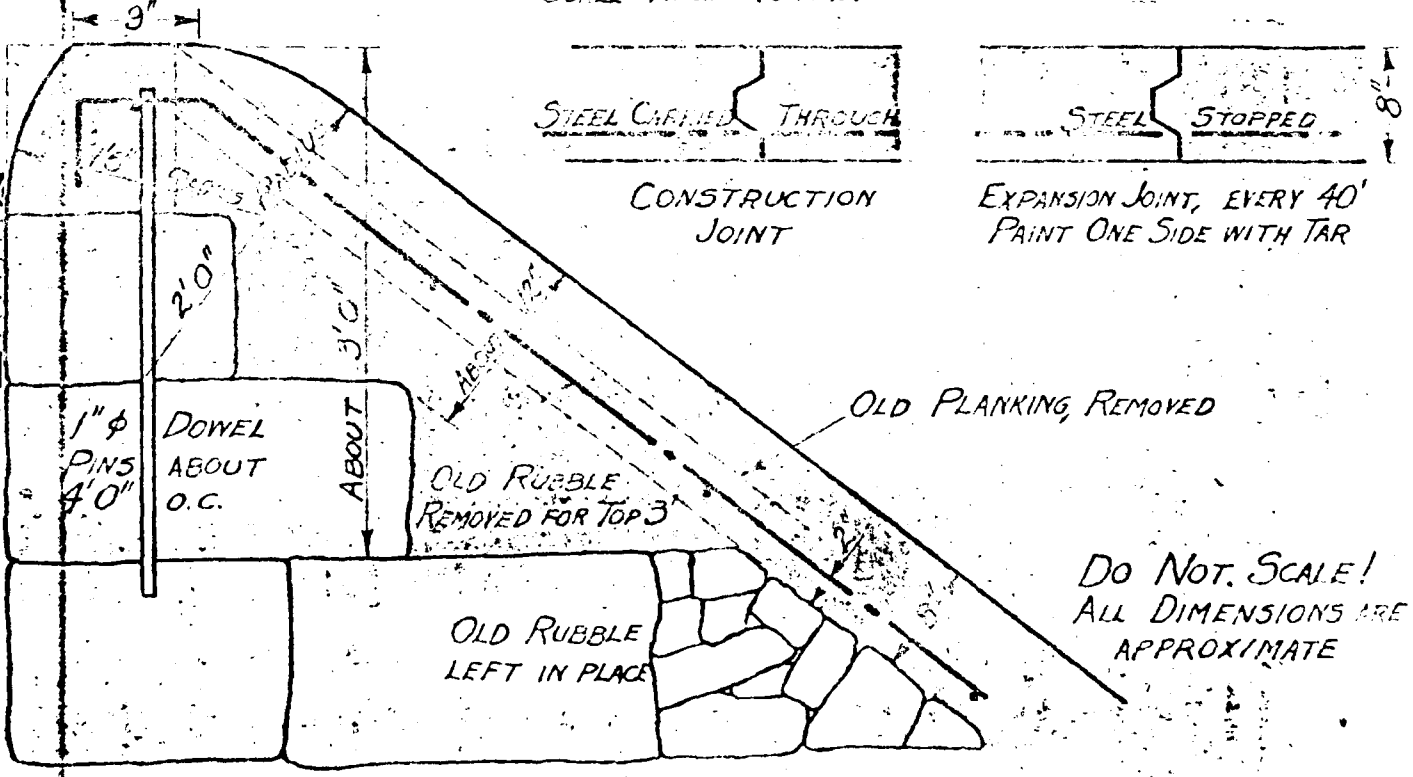


SECTION THROUGH DAM

SCALE 1 INCH = 4 FEET



SECTION THROUGH DAM & COFFERDAM
SCALE 1 INCH = 10 FEET



CONSTRUCTION JOINT

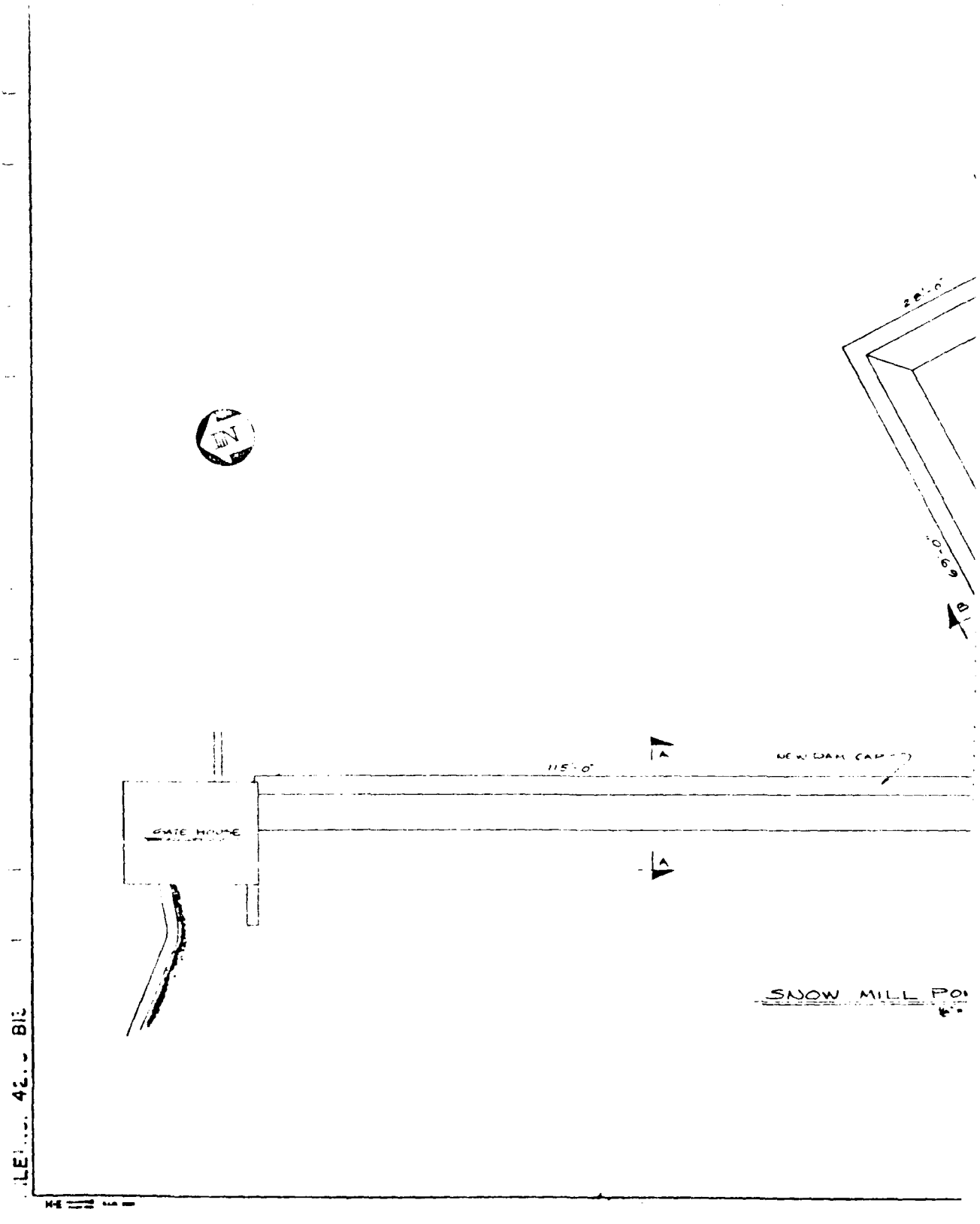
EXPANSION JOINT, EVERY 40'
PAINT ONE SIDE WITH TAR

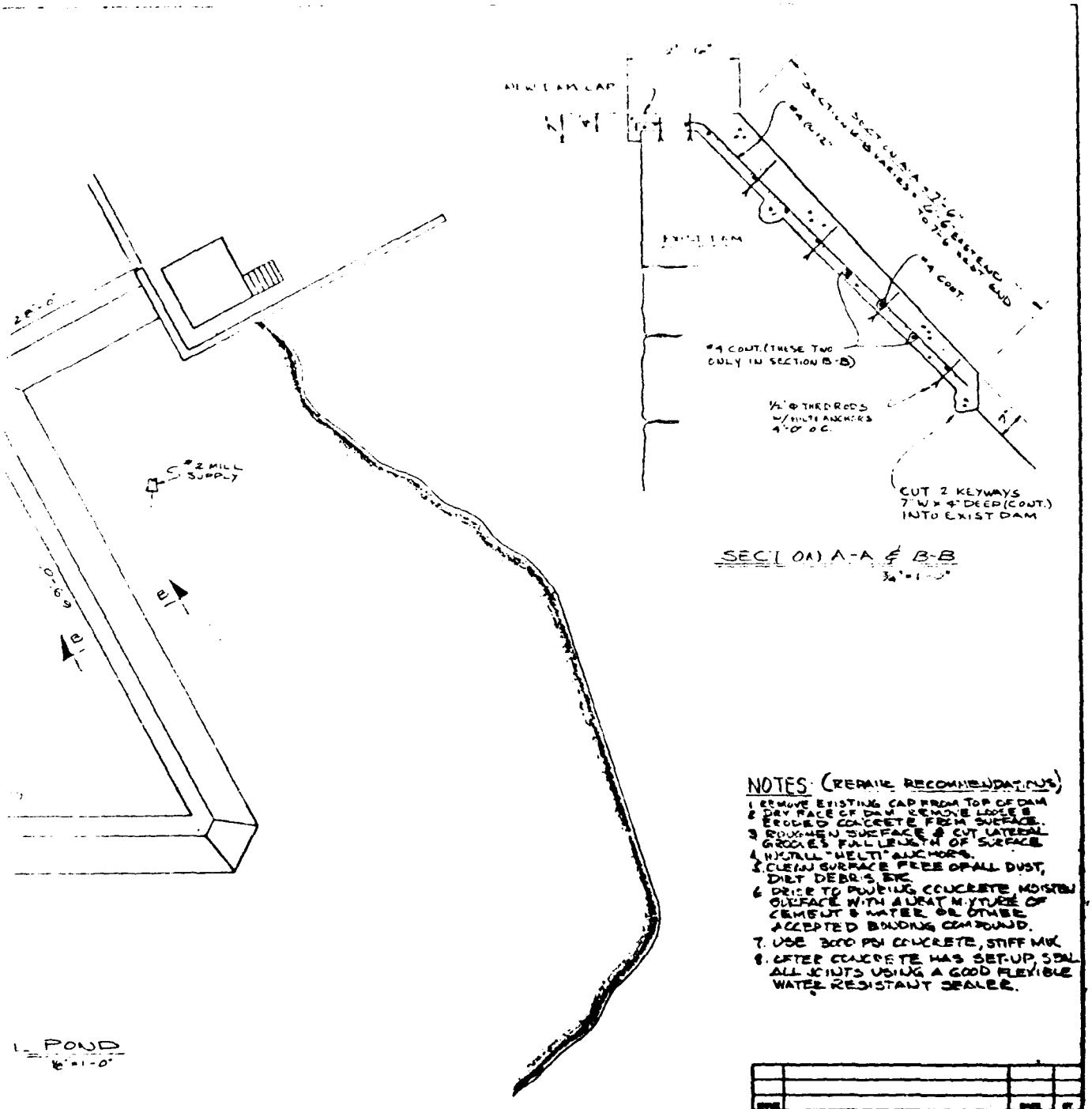
SECTION THROUGH CREST OF DAM
SCALE 1 INCH = 1 FOOT

LOOSE ROCK CAREFULLY

CROCKER BURBANK CO.
FITCHBURG MASS.
REPAIRS TO MASONRY DAM
HOWARD M. TURNER, CONSULTING ENGINEER
12 PEARL ST. BOSTON
OCT. 29, 1924 FILE 962 No. 1

B 20





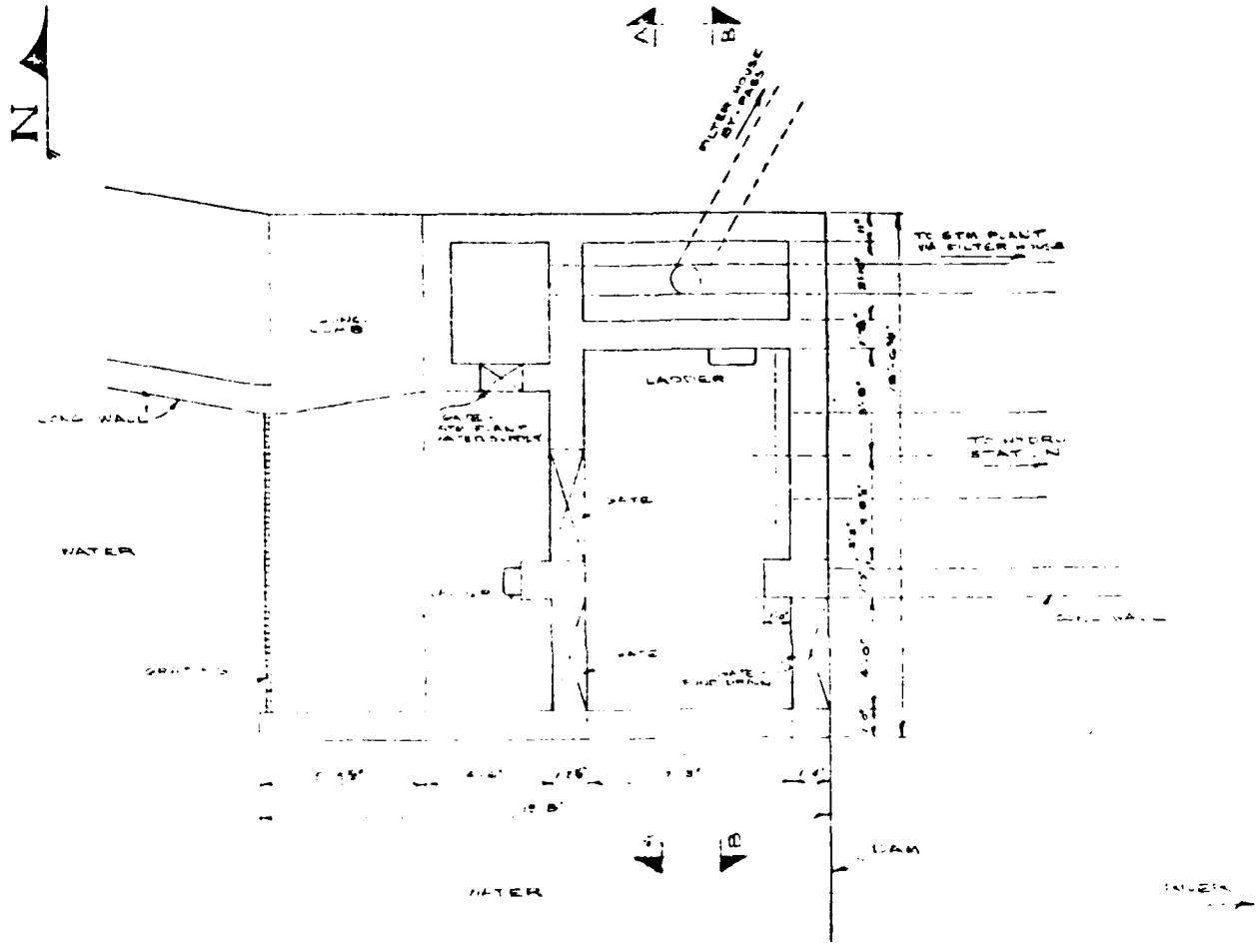
NOTES (REPAIR RECOMMENDATIONS)

1. REMOVE EXISTING CAP FROM TOP OF DAM
2. DRY FACE OF DAM REMOVE LOOSE & ERODED CONCRETE FROM SURFACE.
3. ROUGHEN SURFACE & CUT LATERAL GROOVES FULL LENGTH OF SURFACE
4. INSTALL "HILTI" ANCHORS.
5. CLEAN SURFACE FREE OF ALL DUST, DIRT DEBRIS ETC.
6. PRIOR TO POURING CONCRETE, MOISTEN SURFACE WITH A LIGHT MIXTURE OF CEMENT & WATER OR OTHER ACCEPTED BONDING COMPOUND.
7. USE 3000 PSI CONCRETE, STIFF MIX.
8. AFTER CONCRETE HAS SET-UP, SEAL ALL JOINTS USING A GOOD FLEXIBLE WATER RESISTANT SEALER.

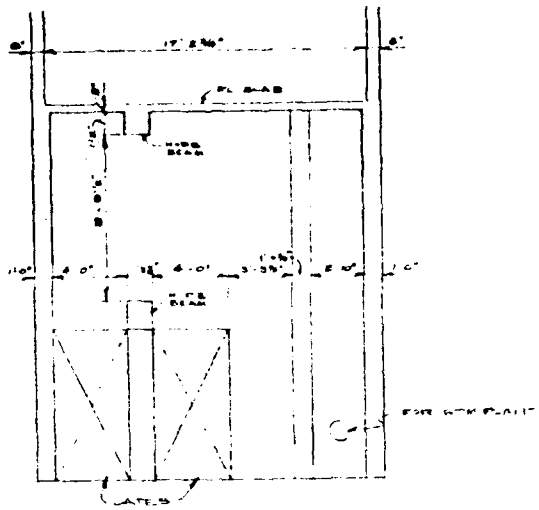
Weyerhaeuser Company
Paper Division

TITLE: SNOW MILL POND - DAM CAP PLAN & SECTIONS
MILL: "A" MILL
SCALE: AS NOTED | DATE: 3-7-77 | NO. OF SHEETS: 1
DRAWN: F. FRANGRAM
DRAWING NUMBER: 8-02-433

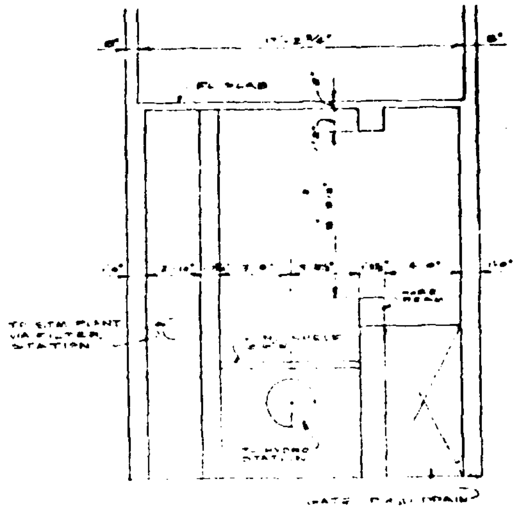
2 of 2



PLAN SNOW MILL GATE HOUSE



SECTION A-A

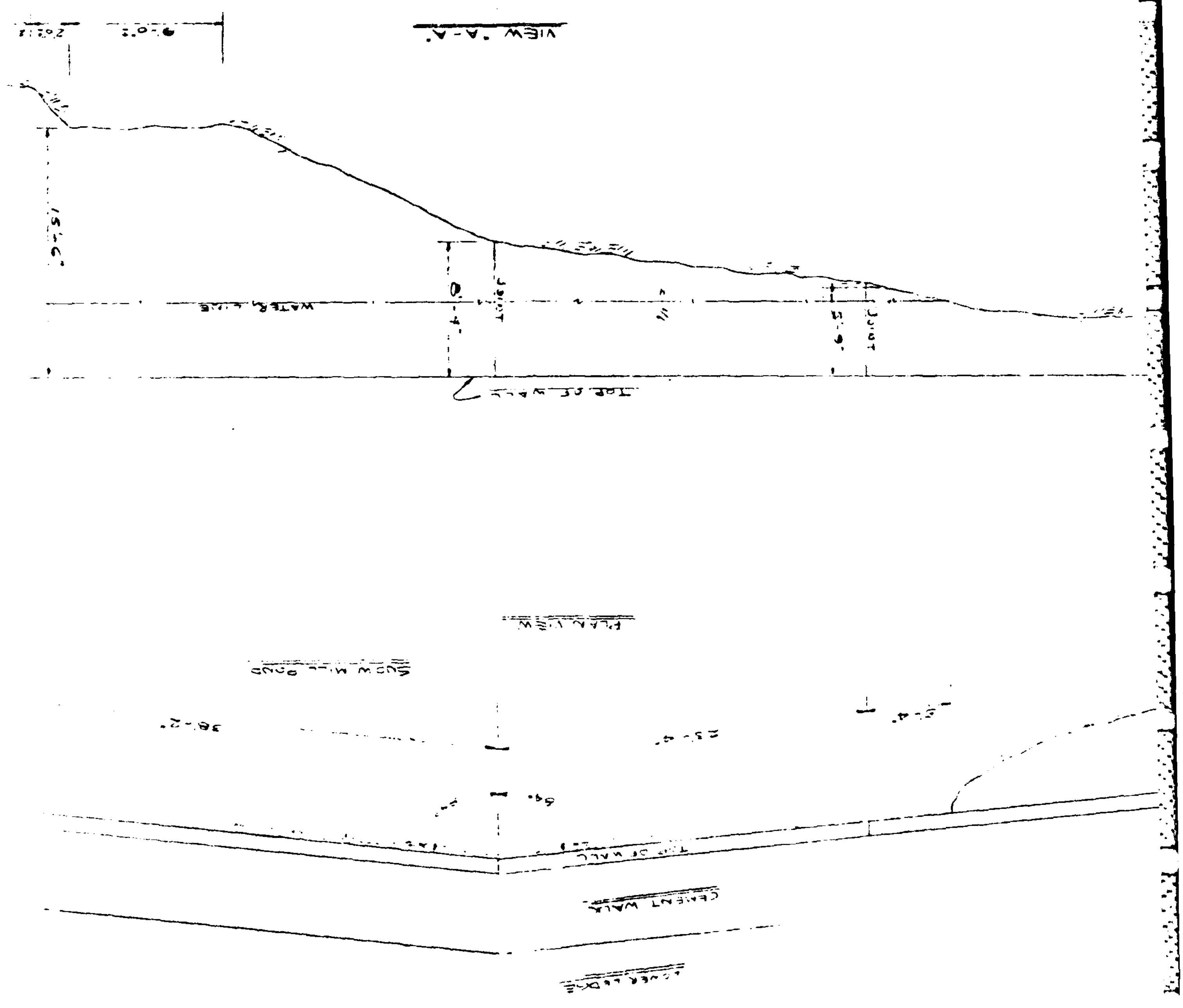


SECTION B-B

JAMES RIVER MA. INC.
FITCHBURG MA
Weyerhaeuser Company
Paper Division

TITLE SNOW MILL GATE HOUSE
EXIST. BEFORE REPAIRS

DRAWING NUMBER
B-0-438



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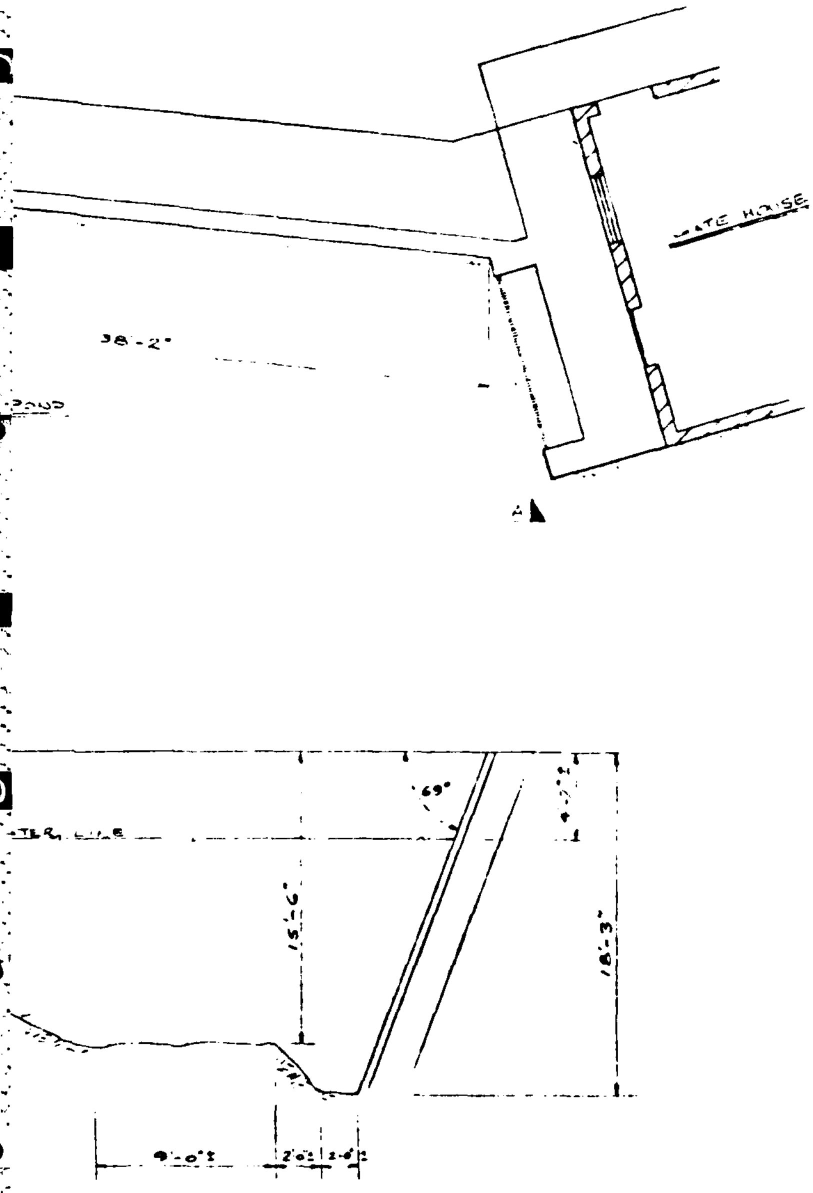

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PAPER DIVISION

ENON MILL GATEHOUSE
RETAINING WALL PLAN & ELEVATION
MILL

F. FLANAGAN

8-Q-450

SNOW MILL POND DAM

1978 IMPROVEMENTS

Removed one gate valve, installed new gasket material.

Added 1/4" thick layer of special Duraweld mix for wearing surface to top and face of dam cap.

Removed loose concrete from cavity in wing wall and filled with concrete.

Removed loose concrete and refaced two (2) exterior gatehouse walls.

Removed dead conduit and wiring.

Repaired broken concrete window sills.

Repaired door and jamb.

Repaired pump to Central Steam Plant.

Repaired pump strainer.

PROPOSED 1979 IMPROVEMENTS

Continue reinforced new underwater wall to cover face of wing wall.

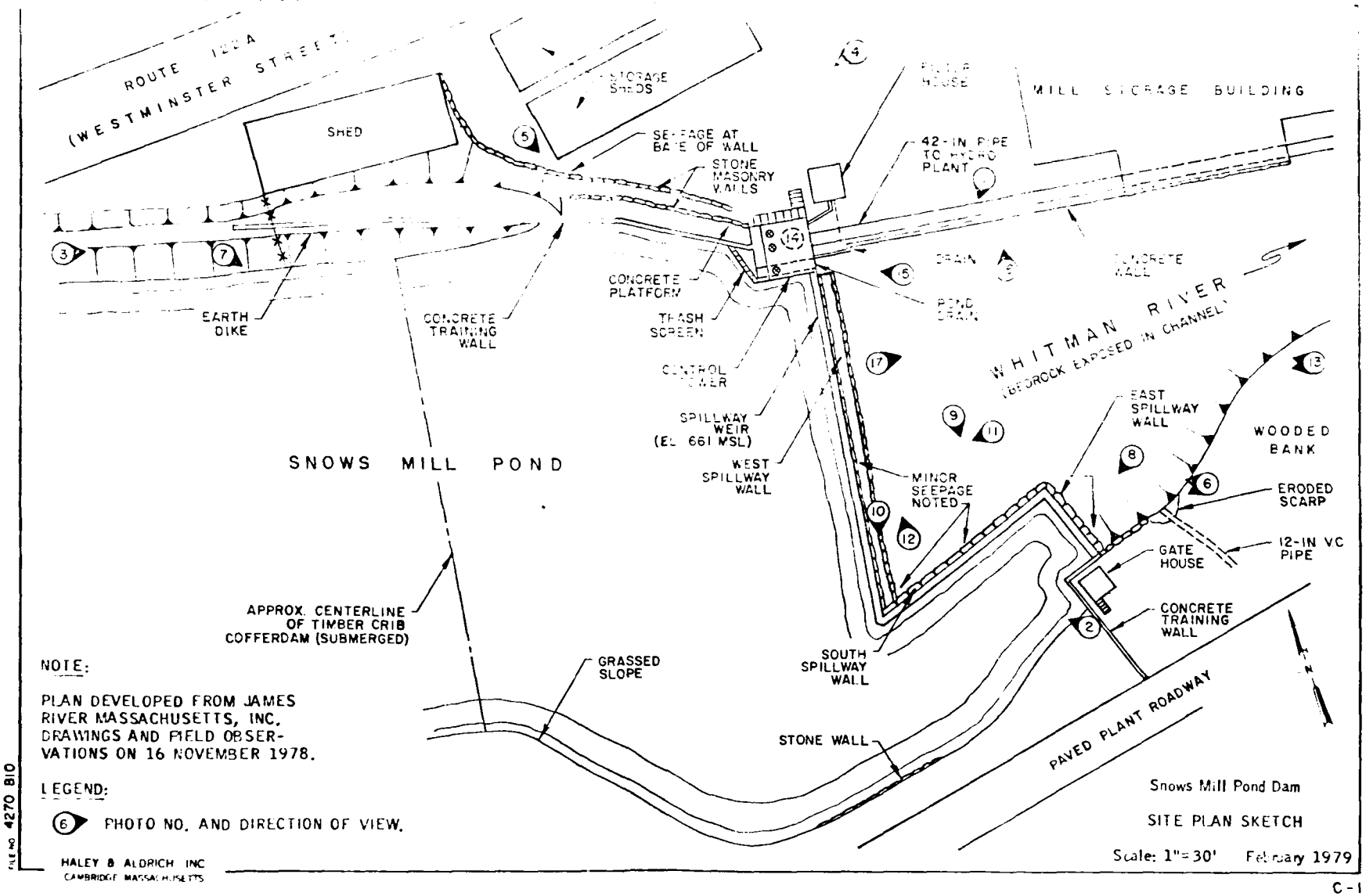
New mud gate.

FF:n

APPENDIX C - PHOTOGRAPHS

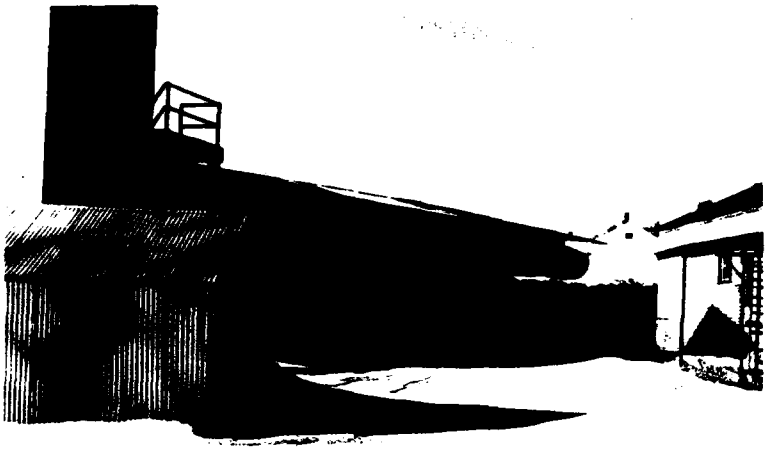
		Page
LOCATION PLAN		
Site Plan Sketch		C-1
PHOTOGRAPHS		

No.	Title	Roll	Frame	Page
1.	Overview of Snows Mill Pond Dam, spillway portion (October 1978)	C31	14A	vii
2.	View across spillway of upstream side of earth dike left of control tower	C22	31	C-2
3.	Earth dike crest from left abutment	5	9	C-2
4.	Stone masonry walls on downstream side of earth embankment (Feb. 1979)	10	14	C-3
5.	Location of seepage through dike at base of stone masonry wall	5	10	C-3
6.	Elevation view of right concrete training wall at gatehouse and downstream spillway	C22	24,25	C-4
7.	Gatehouse and concrete training wall at right abutment of dam	5	7	C-5
8.	Downstream face of east spillway wall	C22	5	C-5
9.	Downstream face of south spill-wall	C22	6	C-6
10.	Apparent seepage at base of south spillway wall near intersection with west spillway wall	C22	13	C-6
11.	Downstream face of west spillway wall, right side	C22	7	C-7
12.	View along downstream face of west spillway wall from right end	C22	9	C-7
13.	Overview of downstream banks and channel	C22	0,1	C-8
14.	Gate operators in control tower for pond drain, penstock to generating station and pipe to filter house	5	12	C-9
15.	Pond drain, penstock to generating station and pipe to filter house downstream of control tower	5	20	C-9
16.	Drain hole and deteriorated concrete at base of concrete wall retaining left bank of downstream channel	4	22A	C-10
17.	View downstream from dam showing exposed bedrock and boulders in channel	C22	17	C-10

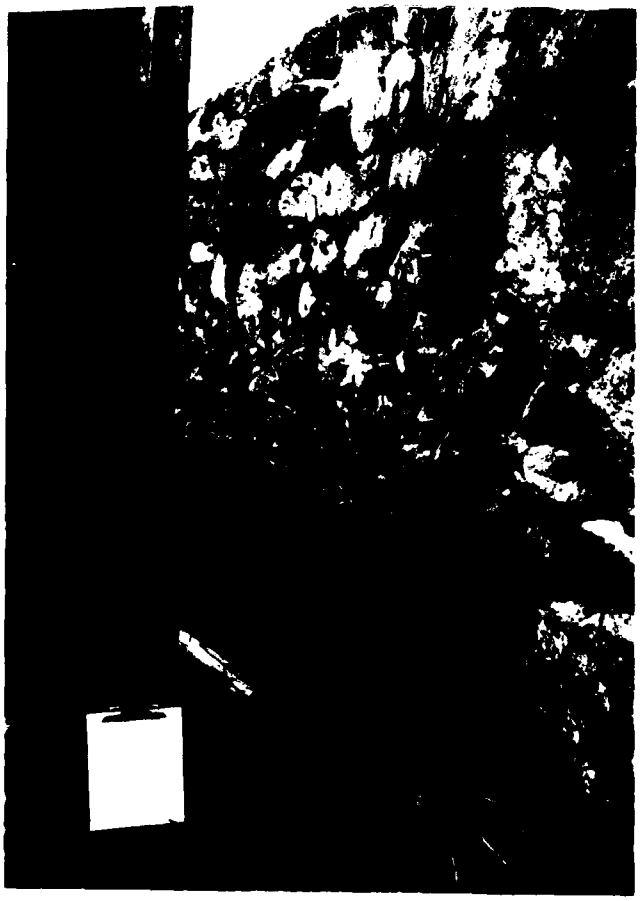

ROUTE 12A
(WESTMINSTER STREET)
SHED
STORAGE SHEDS
SEEPAGE AT BASE OF WALL
STONE MASONRY WALLS
42-IN PIPE TO HYDRO PLANT
MILL STORAGE BUILDING
EARTH DIKE
CONCRETE TRAINING WALL
CONCRETE PLATFORM
TRASH SCREEN
CONTROL GATE
SPILLWAY WEIR (EL 661 MSL)
WEST SPILLWAY WALL
SNOWS MILL POND
DRAIN
POND DRAIN
CONCRETE WALL
WHITMAN RIVER
(BEDROCK EXPOSED IN CHANNEL)
EAST SPILLWAY WALL
WOODED BANK
ERODED SCARP
MINOR SEEPAGE NOTED
GATE HOUSE
12-IN VC PIPE
CONCRETE TRAINING WALL
APPROX. CENTERLINE OF TIMBER CRIB COFFERDAM (SUBMERGED)
GRASSED SLOPE
SOUTH SPILLWAY WALL
STONE WALL
PAVED PLANT ROADWAY
N
NOTE:
PLAN DEVELOPED FROM JAMES RIVER MASSACHUSETTS, INC. DRAWINGS AND FIELD OBSERVATIONS ON 16 NOVEMBER 1978.
LEGEND:
6 PHOTO NO. AND DIRECTION OF VIEW.
FILE NO 4270 810
HALEY & ALDRICH INC
CAMBRIDGE MASSACHUSETTS
Snows Mill Pond Dam
SITE PLAN SKETCH
Scale: 1"=30' February 1979

2. View across spillway of upstream side of earth dike left of control tower

3. Earth dike crest from left abutment



4. Stone masonry walls on downstream side of earth embankment (February 1979)



5. Location of seepage through dike at base of stone masonry wall

6. Elevation view of right concrete training wall at gate house and downstream face of spillway

7. Gatehouse and concrete training wall at right abutment of dam

8. Downstream face of east spillway wall

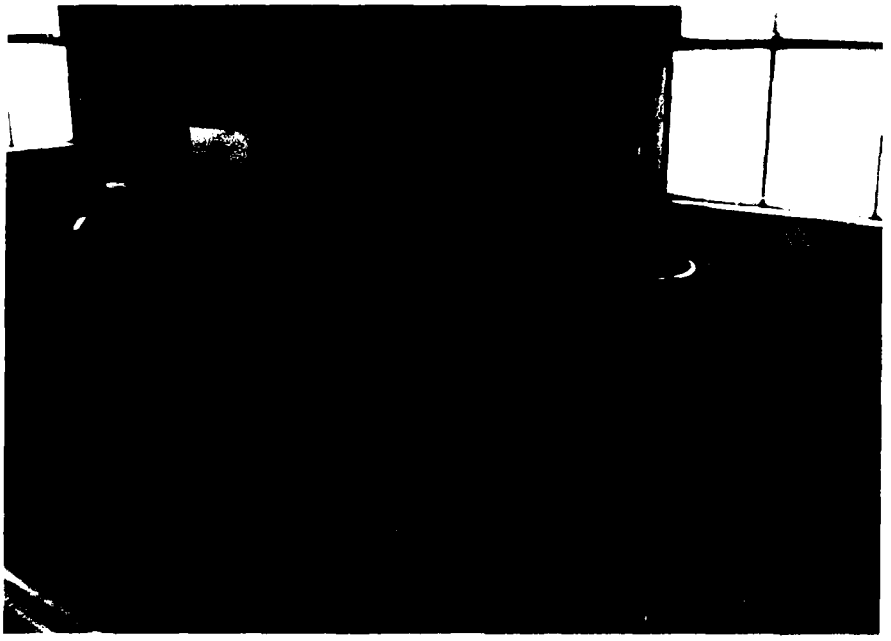
9. Downstream face of south spillway wall

10. Apparent seepage at base of south spillway wall near intersection with west spillway wall

11. Downstream face of west spillway wall, right side

12. View along downstream face of west spillway wall from right end

13. Overview of downstream banks and channel



14. Gate operators in control tower for pond drain, penstock to generating station and pipe to filter house

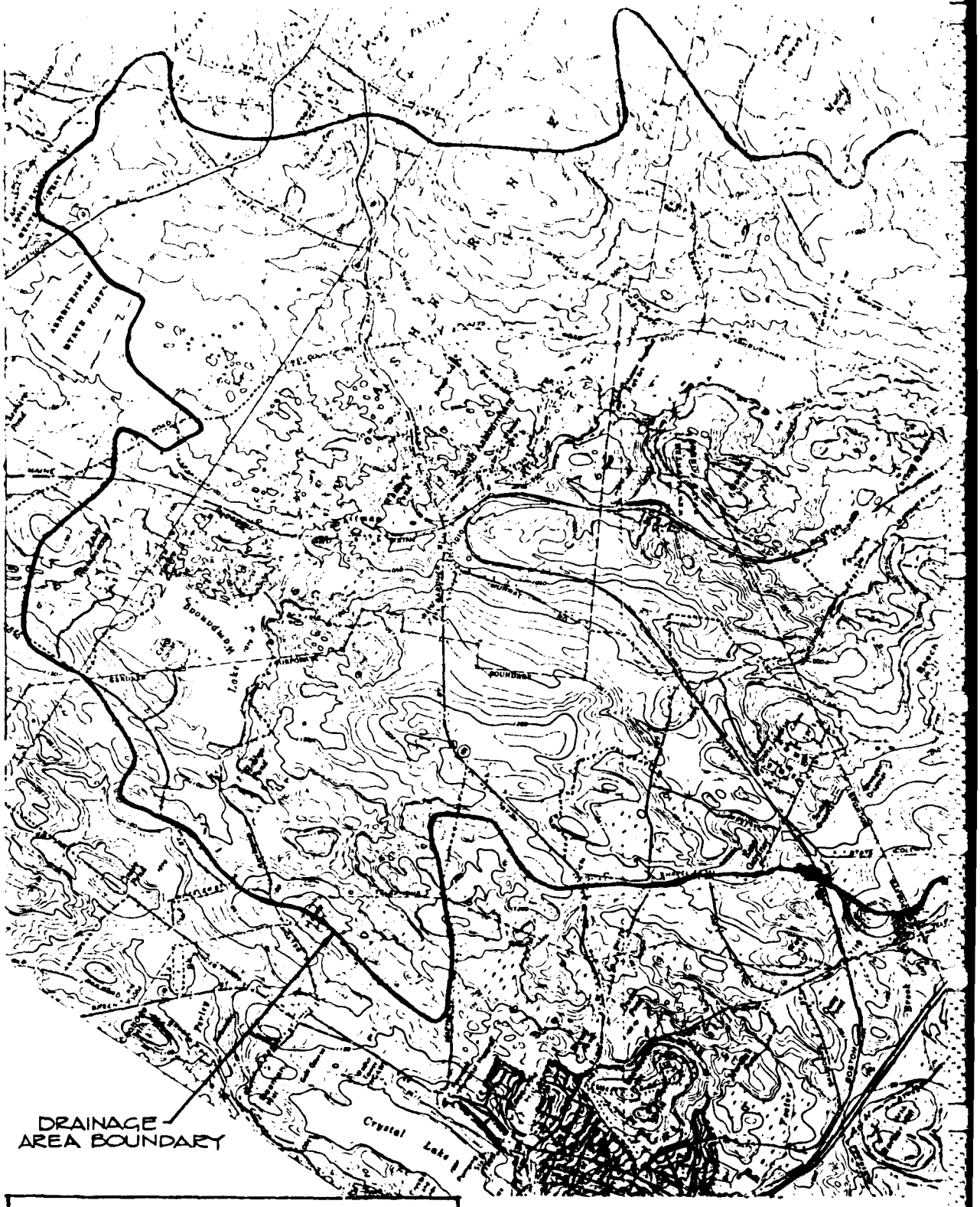
15. Pond drain, penstock to generating station and pipe to filter house downstream of control tower

16. Drain hole and deteriorated concrete at base of concrete wall retaining left bank of downstream channel

17. View downstream from dam showing exposed bedrock and boulders in channel

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

	Page
Drainage and Flood Impact Area Map	D-1
Size Classification, Hazard Potential and Test Flood	D-2
Surcharge-Storage Routing	D-4
Spillway Stage-Discharge Curve	D-5
Area-Volume Curve	D-6
Tail Water	D-7
Whitman River Profile	D-8
Dam Failure Analysis	D-9



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Consulting Engineers
Boston, Mass.

14

SNOWS MILL POND DAM
DRAINAGE & FLOOD IMPACT
AREA
SCALE: 1:40,000

D-1

2 of 2

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DETAIL Snows Mill Pond Dam

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Size classification

Hydraulic height of the Spillway : 661.0 − 638.0 = 23.0 ft.
Hydraulic height of the dyke : 666.0 − 651 = 15.0 ft

Storage @ top of the dam : 740.0 acre-ft.

Size classification : SMALL

Hazard Potential

Development downstream of the dam is extensive, consisting of manufacturing plants, warehouses and some office buildings. The immediate area that would be affected by a dam failure is between the Routes 2A and 31. This area along the Route 31 north of the Whitman river, was flooded during the record flow of 18 March 1936, resulting in damages to several buildings and to the road. A dam failure with the water surface at the top of dam would produce a flood wave with a peak flow, about two and a half times of the March 1936 flood. Therefore, Hazard Potential Classification is HIGH.

Test Flood

Drainage Area: 27.5 sq mi, consists of mostly rolling terrain with some steep hills and about 500 acres of water surface area of the upstream ponds.

From COE Guidelines:

PMF = 1400 cfs/sqmi x 27.5 sqmi = 38,500 cfs.

Test Flood: High Hazard & Small class: ½ PMF ~ PMF

After considering the downstream conditions in general and the standard Project Flood flow of 11500 cfs which was developed by COE in 1965 for the Whitman river ½ PMF = 19250 cfs was selected for further studies. The existing five upstream reservoirs would have a reducing impact on this flow. General characteristics of these dam and reservoirs are shown in the following table:

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DETAIL Snows Mill Pond Dam

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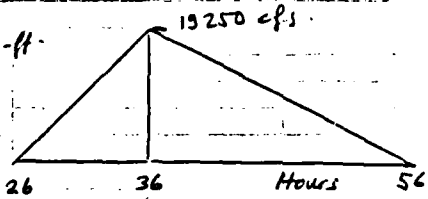
GENERAL CHARACTERISTICS OF UPSTREAM DAMS & RESERVOIRS

Dam	Drainage Area (sq mi)	Drainage Area Cumulative (sq mi)	Spillway Length ft	Spillway Max. Flow Depth (ft)	Spillway Type	Reservoir Area (acres)	Normal Storage Volume (ac-ft)
Wampanoug (Ballou)	2.92	2.92	60	5.5	B.C.	202	1,800
Whitney Pond	1.07	3.99	–	–	–	8	32
Westminster	7.61	11.60	50	8.0	Ogee	117	1,125
Cracker Pond	8.73	20.33	120	8.5	Ogee	104	1,140
Round Meadow	4.09	24.42	–	–	–	62	210
					Total:	493	

If a 4-ft surcharge is assumed for the spillways, a retarding volume of about 2000 acre-ft would be available. By application of 19250 cfs on the flood hydrograph which was developed for the North Nashua basin by COE, the resulting peak discharge can be calculated:

$V \cong \frac{1}{2}\ 19250 \times 3600 \times 30 / 43560 = 14250$ ac-ft



Qpeak upstream of Snows Mill Pond:

$19{,}250 \dfrac{14250-2000}{14{,}250} = 16{,}600$ cfs.

The total piped outlet capacity was estimated to be about 300 cfs, but it was ignored for this study.

Test Flood Inflow: 16,600 cfs.

This is about 50 percent more than the SPF established by COE in 1965; SPF = 11,500 cfs.

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Surcharge - Storage Routing.

Q_{p_1} = 16600 cfs.

WSE : 668.30 (See Stage - Discharge curve)

Surcharge Volume : 1000 - 316 = 684 ac-ft. (See Area & Volume curve)

$STOR(1) = \frac{684 \times 12}{27.5 \times 640} = 0.47$ -in

$Q_{p_2} = Q_{p_1}\left(1 - \frac{STOR(1)}{9.5}\right) = 16,600\left(1 - \frac{0.47}{9.5}\right) = 15,800$ cfs.

WSE = 668.0

Surcharge Volume: 965 - 316 = 650 ac-ft.

$STOR(2) = \frac{650 \times 12}{27.5 \times 640} = 0.45$ -in close enough.

Test flood outflow = 15,800 cfs.

WSElev. = 668

Dam being overtopped by 2.0 -ft.

Spillway depth required: WSE = 668.50

Dam must be raised at least by 2.5 -feet.

Repeat for Standard Project Flood Flow of 11500 cfs.

Q_{p_1} = 11,500 cfs.

WSE = 667.0

Surcharge Volume : 840 - 316 = 524 ac-ft.

$STOR(1) = \frac{524 \times 12}{27.5 \times 640} = 0.36$ -in

$Q_{p_2} = 11500\left(1 - \frac{0.36}{9.5}\right) = 11,100$ cfs. → WSE = 666.80

Surcharge Volume: 826 - 316 = 510 ac-ft $STOR(2) = 0.35$ -in

Test flood outflow = 11,100 cfs. WSE = 666.80 O.K.

Dam would be overtopped by about 0.8-ft.

The spillway depth req'd: 1.0 -ft or elev. for top of Dam = 667.0.

additional

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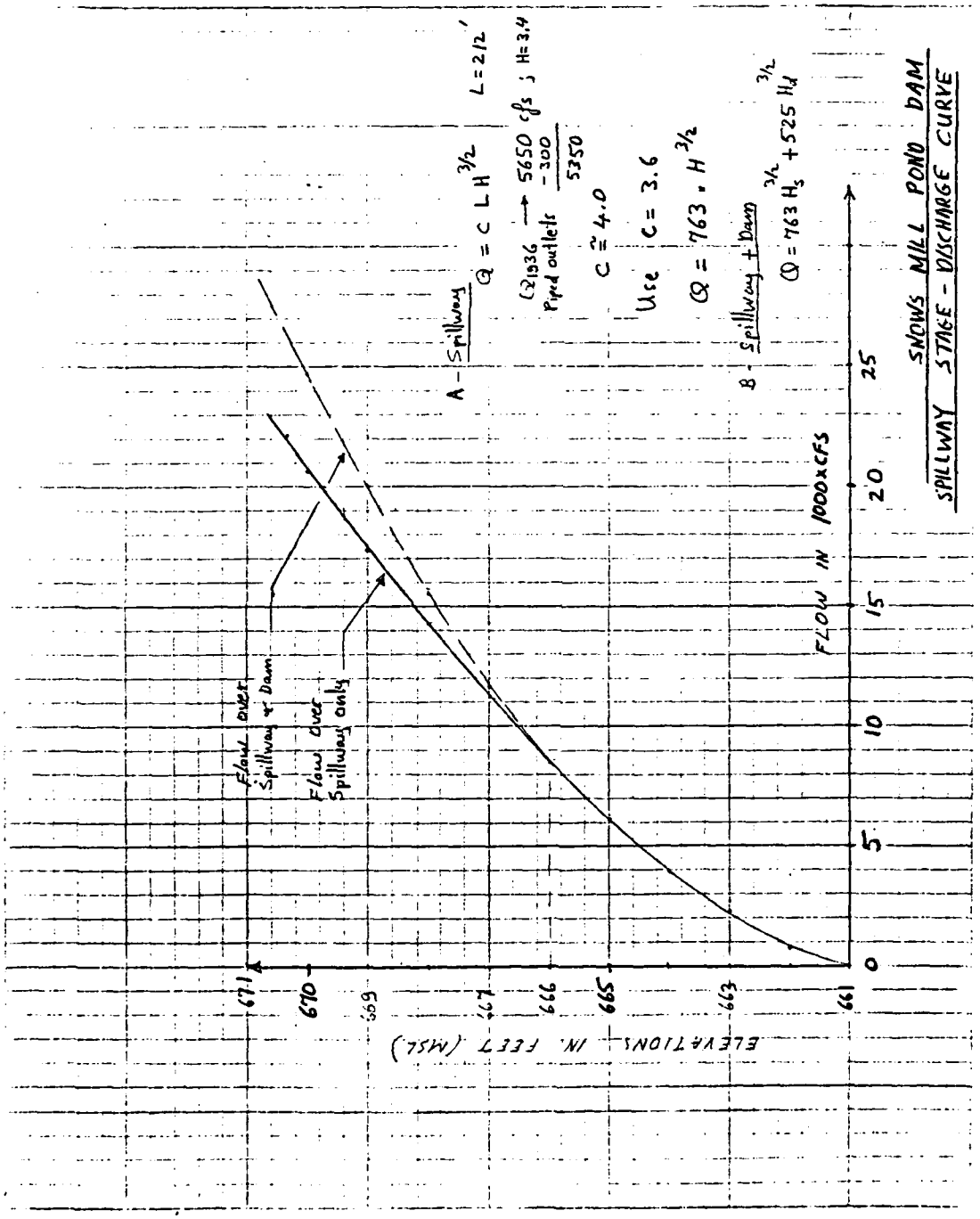

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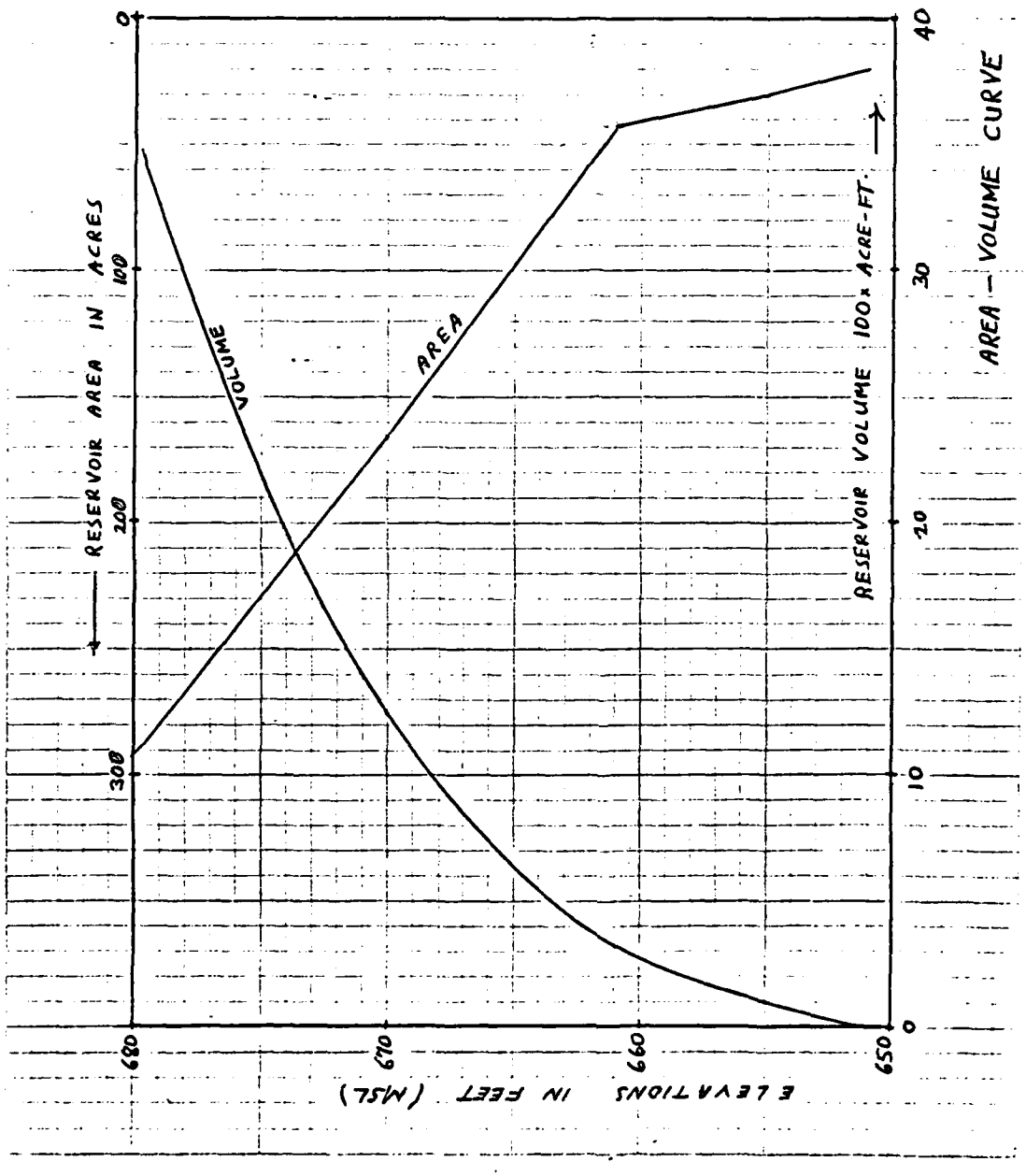


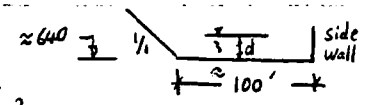
Tail Water :

Test flood outflow : 15,800 cfs.

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$n = 0.035$

$S = 0.032$ $\sqrt{S} = 0.179$ (See profile)



try $d = 6$-ft → $A = 618$ sf, $W = 107$ } $R^{2/3} = 3.11$

$Q = 7.62\ A R^{2/3} = 14,626$ cfs. < 15,800

Try $d = 6.5$-ft → $A = 671$ sf $R^{2/3} = 3.24$

$Q = 16,574$ cfs. > 15,800 cfs.

$d \simeq$ 6.3 ft. WSE : 640 + 6.3 = 646.3 < 661

$V \simeq 24$ fps.

Water depth and velocity would increase as the channel section would get narrower towards downstream.

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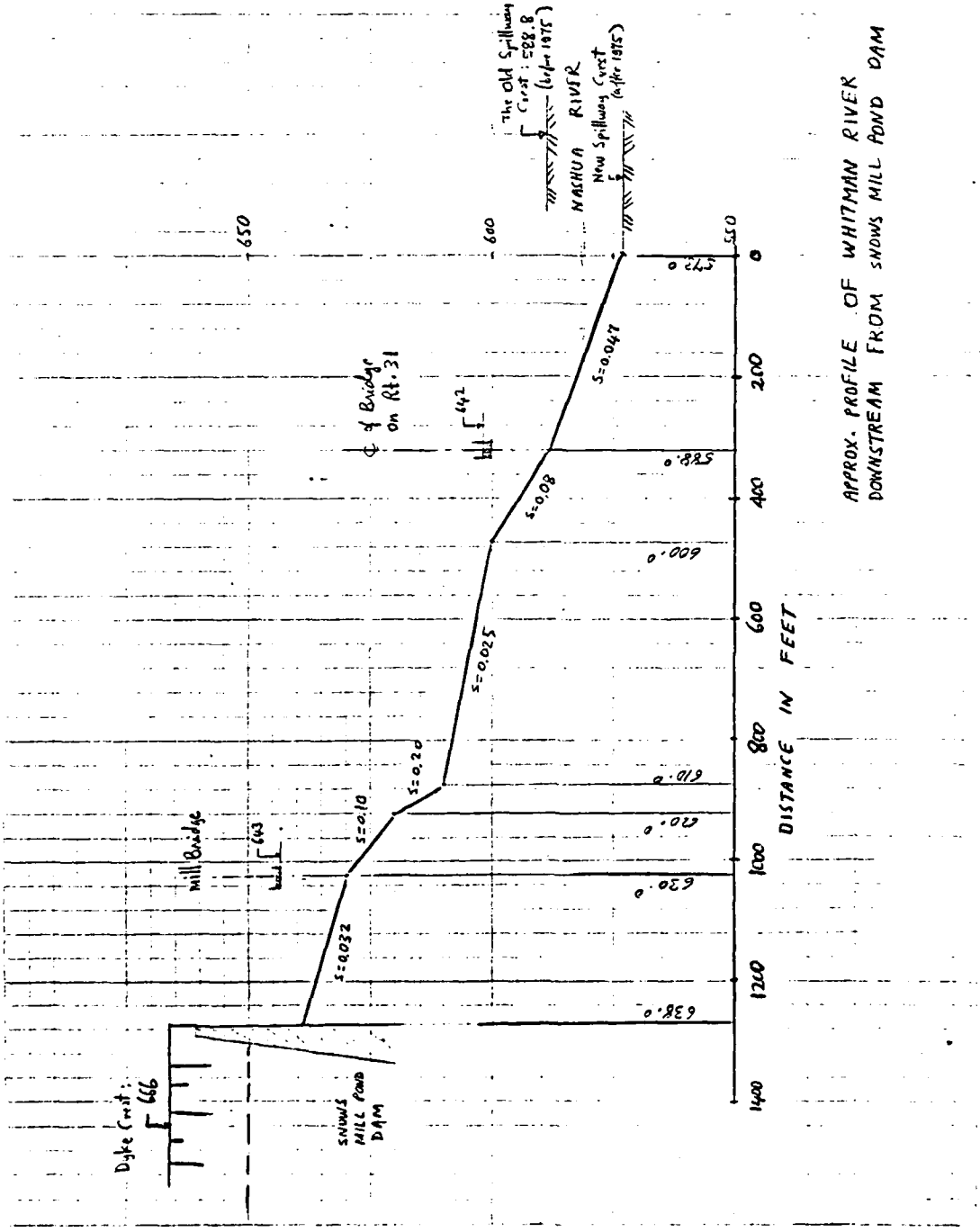
APPROX. PROFILE OF WHITMAN RIVER
DOWNSTREAM FROM SNOWS MILL POND DAM



Dam Failure Analysis (spillway section)

$$Q_{P_1} = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2}$$

$W_b \approx 0.4 \times 120 = 48$ -ft. (See Section on Page D-10)

$Y_o = 666 - 638 = 28$ -ft.

$Q_{P_1} = \frac{8}{27} 48 \times 5.67 \times 148 \approx 12{,}000$ cfs.

Downstream Channel

$Q_{P_1} = 12{,}000$ cfs

WSE @ the pond : 666.0 (assumed at top of the dam)

S = Storage @ time of failure: 740 ac-ft.

Reach : 1 : between the dam and the Wooden Mill Bridge:

Bottom elev. of the bridge Deck : ≈ 643.0
Channel bottom elev. @ Bridge : ≈ 630.0
Channel bottom : Ledge & Boulders.
Channel Gradient : [redacted] 0.032

For approximate channel section and Stage - Discharge curve see page : D-11 :

$Q = 12{,}000$ cfs $\rightarrow$ $d = 7.8$ -ft ; WSE = 637.8

Reach Volume : $V_1 = \frac{103 \times 6.3 + 60 \times 7.8}{2} \times 240 = 133{,}920$ cu-ft

$V_1 = 3$ ac-ft negligible.

WSE during a failure would be about 4-ft below the bridge deck; Velocity in the channel would reach to 25 cfs level.

AD-A155 497 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
SNOWS MILL POND DAM (... (U) CORPS OF ENGINEERS WALTHAM
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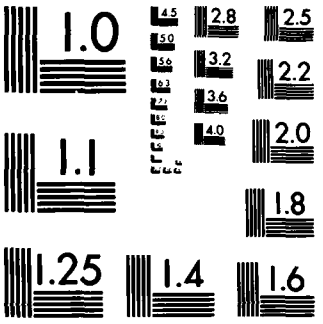

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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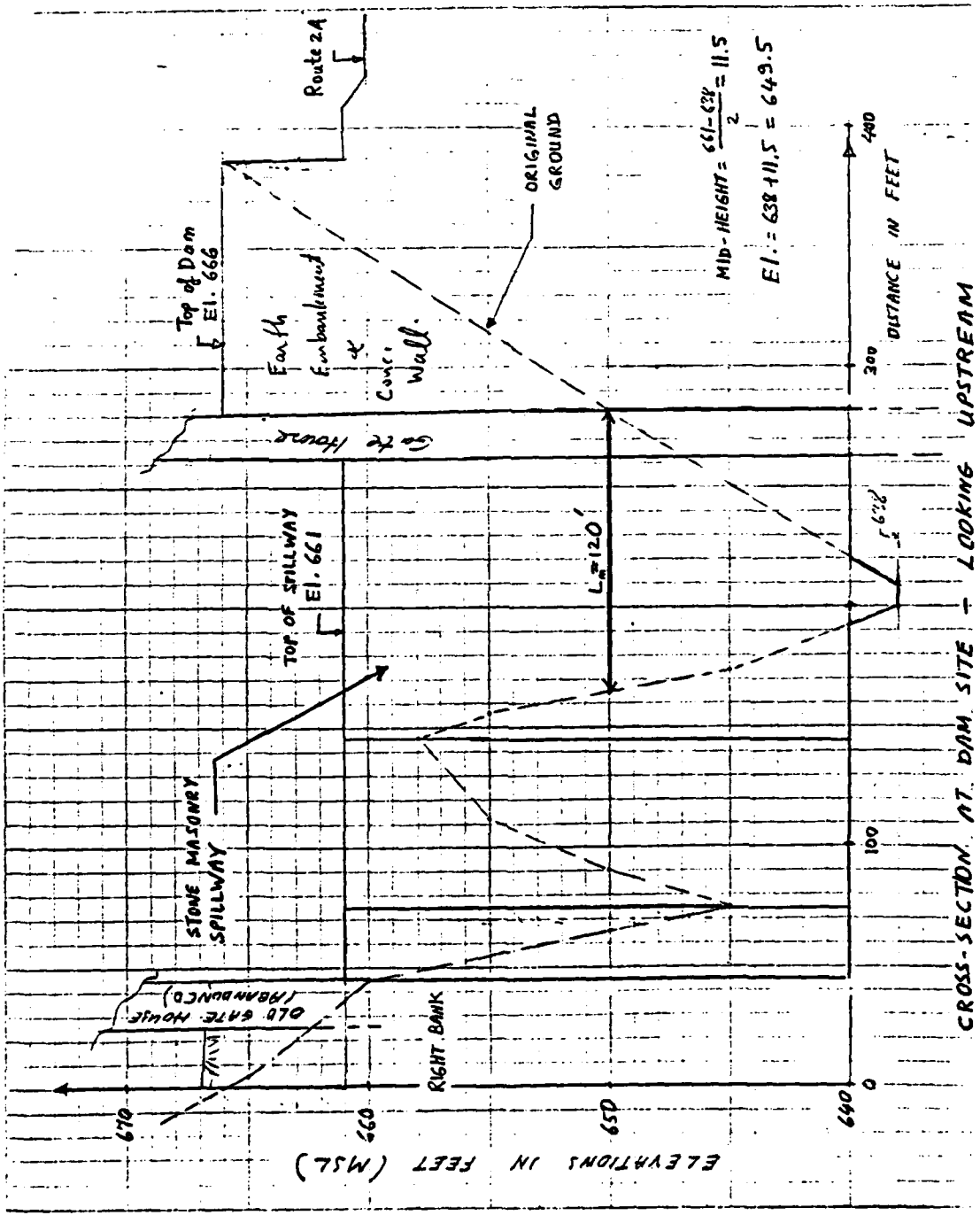

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DETAIL SNOWS MILL POND DAM

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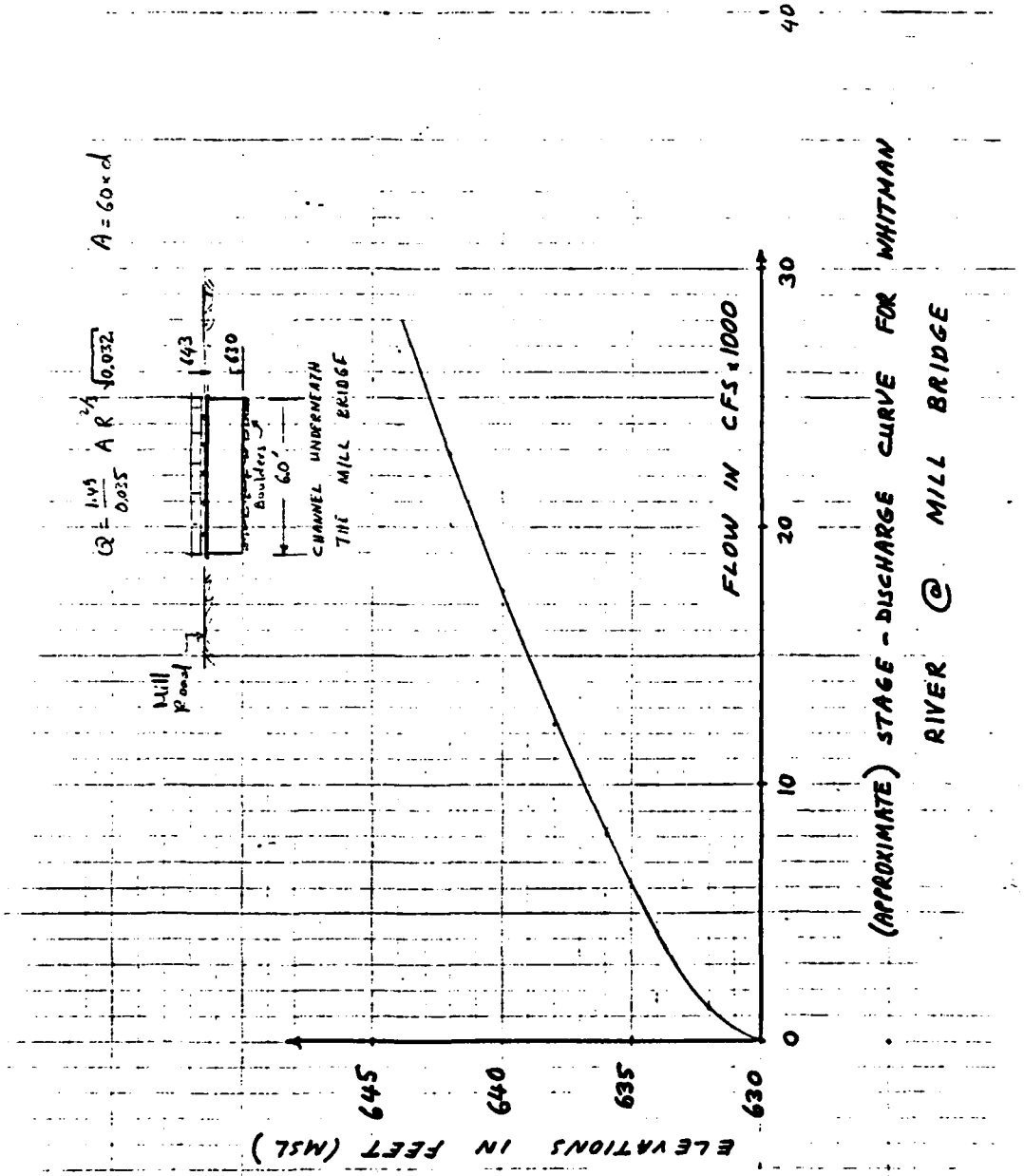

Downstream Channel - Reach 2 : (between the Mill Bridge and the Route 31 Culvert: Volume of this reach is also small in comparison to the total volume of the failure flow), Q_{p_1} = 12,000 cfs .

The culvert is a stone-block arch type, width = 40-ft and height = 12-ft. The length is about 30-ft.

The dam on the upper Nashua river, at the confluence of the Whitman River and the Flagg River, was demolished and rebuilt at an elev. of 573 which is about 16-ft below the old crest. This work was completed in 1975.

A quick checking of the stage-capacity for this new overflow dam indicated that the surcharge at the dam failure flow from the Whitman river would not submerge the culvert under Route 31 (free outlet).

The maximum capacity of the culvert was estimated with utilization of the Manning formula:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2} \qquad n \cong 0.035 \qquad S = 0.047 \text{ (USGS)}$$

$$Q = 9.24\, A R^{2/3} \qquad Q_{max} = 8{,}500 \text{ cfs} \rightarrow d \cong 10\text{-ft}.$$

V_{max} = 26 fps. The max-capacity is smaller than the dam failure flow of 12,000 cfs. The differential flow would back-up and would flood the adjacent low-lying areas, particularly the area extending in the northeasterly direction along the Route 31.

Dam Failure Analysis @ Dyke Section

$$Q_{p_1} = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2} \qquad W_b = 38 \cdot 0.4 \cong 15\text{-ft}.$$
$$Y_o = 666 - 651 = 15\text{-ft}$$

$Q_{p_1} \cong 1{,}500$ cfs

The failure flood water would hit the nearby office building and run downhill on Route 2A, disrupting the traffic and flooding the dwellings near Route 31.

Conclusion: The peak discharge on Whitman river for the 1936 flood of record was 5650 cfs. Damages resulting from this flood was severe. Since the peak failure outflow resulting from a failure of the spillway would be more than twice the 1936 flood, it can be concluded that a failure would cause severe damages to several manufacturing plants, warehouses and to some office buildings in addition to the possible damages to Routes 2A and 31.

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY	MO	YR

POPULAR NAME	NAME OF IMPOUNDMENT

REGION/BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	NORMAL (ACRE-FT.)	[illegible]

REMARKS

DAM HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	[illegible]

OWNER	ENGINEERING BY	CONSTRUCTION BY

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE

INSPECTION BY	INSPECTION DATE DAY	MO	YR	AUTHORITY FOR INSPECTION

REMARKS

END

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